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REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

AD-A202 392

1b. RESTRICTIVE MARKINGS
- -

3. DISTRIBUTION/AVAILABILITY OF REPORT
Approved for public release; distribution is unlimited.

4. PERFORMING ORGANIZATION REPORT NUMBER(S)
- -

5. MONITORING ORGANIZATION REPORT NUMBER(S)
ARI Research Note 88-95

6a. NAME OF PERFORMING ORGANIZATION
Applied Science Associates, Inc.

6b. OFFICE SYMBOL (If applicable)
- -

7a. NAME OF MONITORING ORGANIZATION
U.S. Army Research Institute for the Behavioral and Social Sciences

6c. ADDRESS (City, State, and ZIP Code)
P.O. Box 1072
Butler, PA 16002
16003

7b. ADDRESS (City, State, and ZIP Code)
5001 Eisenhower Avenue
Alexandria, VA 22333-5600

8a. NAME OF FUNDING/SPONSORING ORGANIZATION
see 7a.

8b. OFFICE SYMBOL (If applicable)
PERI-SM

9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
OPM-85-19, W.O. # 319-072

8c. ADDRESS (City, State, and ZIP Code)
see 7b.

10. SOURCE OF FUNDING NUMBERS

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT ACCESSION NO.
6.27.17	2Q1627 17A790	1.2.7 1.4.2	127C1, 142C1

11. TITLE (Include Security Classification)
Market Survey and Analysis in Support of ASAS Computer-Based Training System Design

12. PERSONAL AUTHOR(S) Gary Witus, Belinda J. Bicknell, W. Peter Cherry (Vector Research, Inc.)
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13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Final Report	FROM 87-4 TO 87-7	November 1988	183

16. SUPPLEMENTARY NOTATION
Dorothy L. Finley, contracting officer's representative

17. COSATI CODES		
FIELD	GROUP	SUB-GROUP

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
Computer Based Training
Embedded Training
Training Technology

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

This research note describes a market survey of computer-based training technology conducted to provide a basis for design decisions in the All Source Analysis System/Enemy Situation Correlation Element (ASAS/ENSCE) program. This information was evaluated within the context of three alternative training equipment configurations, and a recommendation was made for the selection of one of the three. The appendixes of the note present the information obtained on current computer based training systems, authoring systems, image scanners, monitors, and graphics boards.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT
☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS

21. ABSTRACT SECURITY CLASSIFICATION
Unclassified

22a. NAME OF RESPONSIBLE INDIVIDUAL
Dorothy L. Finley

22b. TELEPHONE (Include Area Code)
202/274-8876

22c. OFFICE SYMBOL
PERI-SM

DD Form 1473, JUN 86 Previous editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE
UNCLASSIFIED

ARI Research Note 88-95

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November 1988

United States Army
Research Institute for the Behavioral and Social Sciences

U.S. ARMY RESEARCH INSTITUTE
FOR THE BEHAVIORAL AND SOCIAL SCIENCES

A Field Operating Agency Under the Jurisdiction of the Deputy Chief of Staff for Personnel

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Research accomplished under contract
for the Department of the Army

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LIST OF ACRONYMS

AIT	Applied Interactive Technologies
ASAS/ENSCE	All Source Analysis System/Enemy Situation Correlation Element
BIOS	Basic Input Output System
CBT	Computer Based Training
CCD	Charged Coupled Device
DEC	Digital Equipment Corporation
DPI	Dots Per Inch
DTR	Digital Data Recovery Board
EGA	Enhanced Graphics Adapter Board
EIDS	Electronic Information Delivery System
H	Horizontal Pixels
I/O	Input Output
KB	Kilobyte
LPI	Lines Per Inch
MB	Megabyte
OCR	Optical Character Recognition
OEM	Operations Engineering Market
R&D	Research and Development
RAM	Random Access Memory
ROM	Read Only Memory
SCSI	Small Computer Standard Interface
V	Vertical Lines
VGO	Virtual Graphics Overlay

EXECUTIVE SUMMARY

Requirement

The purpose of this report is to document the results of a study performed to support the development of a training strategy for the All Source Analysis System/Enemy Situation Correlation Element (ASAS/ENSCE). The focus of the study was the use of Computer Based Training (CBT) in the ASAS/ENSCE, specifically, on the current state of the art and projected advances in CBT technology and on the development of a recommended strategy for incorporating CBT in the ASAS/ENSCE training system.

Approach

In order to establish the state of the art and to project likely advances in CBT technology a survey of currently available components and their manufacturers was carried out. Included in this survey were authoring systems and computer, communication, storage, networking, video I/O, audio/video recording, image scanning, disk pre-mastering, and software development subsystems. Because system integration is a major issue, attention was then focused on three nominal systems which would fulfill the CBT requirements of the ASAS/ENSCE. These requirements, together with an associated set of issues, were developed with the sponsor and served as a basis for preparing a recommendation.

Findings

The results of the surveys carried out during this study are included as appendices to this report. The surveys support the observation that the current state of the art of CBT technology will support ASAS/ENSCE training requirements, for both stand-alone training, and training embedded in the operational system. While it is possible to use operational software in CBT, it is not necessary to do so. It is desirable, however, to use the networking software of the operational system in embedded collective training. Digitizers, the inclusion of which was a design issue, offer clear payoffs to training effectiveness and are well within the state of the art to support the development of training materials in CBT. A related issue, that of authoring courseware in the field, led to the conclusion that a partial, structured capability should be supported in the field, but that overall courseware design should be left to trained courseware developers.

Recommendations

The three nominal alternatives constructed during the study differ primarily in their use of the PAWS as a training device. Because of this they present different development schedules and complexity. It was on this issue, schedule, that a Matrox EIDS-based CBT system was chosen as the best alternative in the opinion of the study team. It utilizes components available and in use within the Army, supports both stand-alone and embedded training, and presents the lowest levels of development risk. Most importantly, the selection of this alternative would enable the ASAS/ENSCE to begin to develop and implement courseware now. This course of action would provide training when and where it is needed, would provide valuable feedback to the ASAS/ENSCE developers, and would not compromise cost-effective training over the life cycle of the system.

SECTION 1

INTRODUCTION

Background

The All Source Analysis System/Enemy Situation Correlation Element (ASAS/ENSCE), a joint Army/Air Force Program, will present interpreted battlefield intelligence information in text and digitized map formats to analysts for integration and analysis. The analysts then prepare the reports that are sent to operations personnel for decision-making. These reports can also be fed back to interpreters to improve subsequent information input. Reports consist of text and/or graphic information. The ASAS/ENSCE analyst terminal hardware consists of a Digital Equipment Corporation VAX computer which presents information on two screens, one of which is a large-format high resolution CRT. The analyst interacts with the system using a standard alphanumeric keyboard and with a free-moving cursor control.

Preliminary analyses indicate that the training requirements for ASAS/ENSCE analysts will probably be extensive, although the total training system has not as yet been configured. Most certainly, interactive videodisk computer-based training technology represents an important training approach that must be considered in the design of both institutional training for acquisition and field training for sustainment. To meet anticipated requirements, the training system will have to be capable of high-resolution digitization and display of hardcopy images, such as maps and photographs. It may also need to be capable of transporting portions of the operational software to the training system for use in exercises. In addition to these major considerations, other training system characteristics will impact the scope and cost-effectiveness of ASAS training, including the compatibility and capabilities of the authoring system, the hardware suite, and the training software. Only by careful tailoring and tradeoffs will the ultimate ASAS training system be capable of meeting all its operational requirements.

Technology in Embedded Training Design, in information processing and display, in computer-generated simulation, and in authoring techniques for training are rapidly evolving and expanding. For ASAS/ENSCE, as for any system early in its development cycle, there are a myriad of hardware, software, and training system configuration decisions which must be resolved. Optimizing the overall effectiveness of ASAS training will require carefully selected training approaches and strategies, and hardware and software design decisions which maximize considerations of compatibility, capability and growth. In particular, for ASAS/ENSCE it is highly critical to maximize the use and effectiveness of computer-based training (CBT) applications.

Purpose

The purpose of this report is to summarize the findings and conclusions drawn from a series of separate analyses which examined the major component alternatives for the ASAS training system. The intent for this report is to serve as an inventory of feasible and available technologies which should impact ASAS training system design. While it is recognized that a very critical set of considerations involving the actual requirements for analyst' training in support of ASAS has not been part of this effort, the findings and conclusions reported here have been formulated by an analytical team with considerable familiarity with those training requirements, as they are knowable at this stage of design, and with the analysis process from which they are derived. Thus, these requirements are felt to accurately reflect the total complex of training system demands which must be fulfilled for effective system support. Even though design decisions and other training systems givens have progressed, and will progress, beyond those assumed in this report, the factual specifications and design issues outlined here still apply. It is hoped that the coming series of tradeoffs which must be made in the final selection and configuration of the ASAS training system can be more focused and factual by the use of the data and insights in this report.

Scope

The scope of this document, and of the analyses it reflects, range widely across the major issues of training system or subsystem development. Existing and available authoring systems were inventoried and described in terms permitting judgments about applicability to ASAS and compatibility with various combinations of hardware and software. The feasibility, uses, and operating characteristics of digitizers for the input of image information is explored. Existing computer-based training systems, including their hardware and software characteristics and capabilities are examined. The potential impacts of various acquisition strategies and of operational employment alternatives for computer-based training are outlined. Finally, a functional description of a desired model of an ASAS training system, in terms of its major subsystems, is portrayed. All of these separate, yet interacting, factors are combined and discussed in terms of eight major ASAS training system design issues. The issues involve:

1. Should the computer-based training subsystem be stand-alone, or some combination of both?

2. At what stage of the development cycle should commitment be made to individual aspects and/or components of the training system.

3. Should field authoring of training materials be permitted, under what conditions, and with what system design impact?

4. In what ways should training considerations drive ASAS's operational system design?

5. What are the appropriate tradeoffs between designing training system components to support input of operational data and designing to support only training data input?

6. To what degree and in what ways can operational software and data be utilized in developing and presenting training materials?

7. What are the constraints on training material development and presentation imposed by ASAS security requirements?

8. Will there be a need for ASAS instructors on operational sites?

Organization and Content

This report is organized to present the described information in a sequence. Section 2 of this report defines the major rationales and operating characteristics of a training system which will meet ASAS training requirements. Eleven subsystems are described in terms of their functional input to the overall training system. The desired training system characteristics cited in this section serve to structure and focus the considerations leading to the selection of design recommendations. In Section 3 each of the eight issues previously itemized are discussed in terms of their impact on ASAS and ASAS training system design. In Section 4 design alternatives which meet, to varying degrees, the desired system characteristics are detailed. In Section 5, various acquisition strategies for ASAS training system design commitment are described and analyzed in terms of their perceived effectiveness and efficiency. In Section 6, the alternative which seems best to resolve all of the significant issues, and which seems best to meet all of the required design characteristics is presented. These recommendations are presented in terms of hardware, software, and implementation strategies.

Four appendices present additional data and insights relevant to ASAS training system design. Appendix A presents a survey of computer-based training systems which can serve as a stand-alone training resource for ASAS. Appendix B provides and inventory of existing authoring systems and their characteristics as they apply to the ASAS training requirements. Appendix C details a survey of available digitizers and the problems of interfacing them with both the training system and the ASAS operational system. Appendix D discusses a survey of monitors and graphic boards in support of designing appropriate configurations of ASAS training hardware and software. Finally, Appendix E discusses the problems in upgrading the Matrox EIDS to permit high resolution image scanning in support of both ASAS training and ASAS field operation.

SECTION 2

ASAS/ENSCE COMPUTER-BASED TRAINING SYSTEM

Goals and Rationale

This report assumes three major goals for the ASAS training system development effort. They are:

1. To produce an overall ASAS training system which will be efficient and effective in supporting total ASAS performance.

2. To make timely and cost-effective decisions concerning hardware/software feasibility, capability, and cost.

3. To adopt a sound development strategy which involves:

    a. Low risk, in terms of timing, cost, and capability.

    b. Appropriate growth potential in the selected design parameters and in accord with technological trends.

    c. Robust versatility to minimize maintenance requirements and to accommodate operational systems evolutionary changes.

To maximize the achievement of all three of these goals will ultimately involve the utilization of CBT in both a stand-alone mode and in an embedded mode. CBT has now a long history of demonstrated effectiveness in technical training, particularly in decision-making cognitive areas. In general, computer-based training means, "an interactive learning experience between a learner and a computer in which the computer provides the majority of the stimulus, the learner must respond, and the computer analyzes the response and provides feedback to the learner."[1]

While this is a useful and descriptive definition, it does not convey the full sense of what CBT could be in the ASAS training context. CBT, whether conducted on separate tabletop terminals or at

[1]Gery, Gloria. Making CBT happen. Boston, MA: Weingarten Publications, 1987.

the operational workstations as embedded training, has a number of unique characteristics, although not all applications of CBT can include all of the advantages which CBT technology offers. For ASAS, the CBT advantages could include:

1. CBT Fits the ASAS Computer Environment. Given appropriatedly sized and acceptable computer capacity, job-relevant and learning-effective training materials (courseware), and a system design which permits isolation of applications programs, CBT in the form of embedded training, can become an integral part of the ASAS system. The applications programs can also be adapted to directly support an ASAS CBT stand-alone training system.

2. CBT Applicable to Both Schoolhouse and On-Site Training. Once the CBT system, consisting of a training database, applications programs, training software, and courseware is in place, the capability of effective training for initial acquisition of ASAS operating skills and sustainment of job-relevant performance capabilities will be transportable.

3. Training At or Near Workstation. In the embedded training mode, CBT can become accessible with, literally, the flick of a switch. Alternatively, a stand-alone, training-dedicated, terminal can, with appropriate planning, be essentially co-located in the working environment. Both configurations provide maximum access to training opportunities.

4. Use of Operational Software. With appropriate selection of the training hardware/software and authoring system, the ASAS training system may be able to make use of at least portions of the operational applications software in the creation of scenarios providing opportunities to practice realistic part-task and full-task performance requirements. Particular system programming complexities, however, may make training-unique emulation of application programs more cost effective than the direct transfer of operational programming to training system simulations.

5. Use of Operational Hardware. The PAWS terminal will be the training location in an ASAS embedded training mode. In this mode, the terminal keyboard and displays used in actual operation are also used in training, maximizing the transfer effect from practice situations to actual system operation.

6. CBT Maximizes Training Standardization. CBT courseware authored at a centralized location and distributed to all training locations can remove much of the potential instructor bias in ASAS training. All trainees will be

exposed to identical material presented in identical ways. To the degree that on-site authoring capability is provided in the CBT system, a highly desirable characteristic under some circumstances, centralized control of training material content and quality is reduced.

7. CBT Facilitates Courseware Tailoring to Meet Site-Unique Requirements. CBT courseware authoring, whether done on-site or at a centralized location, will permit the preparation of ASAS analysts' training which is tailored to the specific performance requirements of any particular site or any particular group of trainees. While standardized training may suffice for all of ASAS analyst training, the ability to fine-tune the training provided at any particular location to the unique requirements of that location or situation can have significant benefits.

8. CBT Training is Trainee-Paced and Controlled. Self-paced training does not commit any trainee to an arbitrarily chosen rate of training presentation, but allows each to proceed at a self-determined effective pace. Similarly, in a menu-driven curriculum, the trainee can elect to re-examine certain portions of previously conducted training or can be selective in the lesson content taken at any particular time.

9. CBT is Interactive. The learning process is significantly enhanced by having the trainee actively participate in the training process. By its very nature, CBT promotes interactivity. Well-designed CBT will ensure a high level of appropriate trainee response, and will provide feedback tailored to the nature of that response.

10. CBT Can Be Made Adaptive. Just as a good instructor adapts his teaching technique, pace, and content to the abilities and perceived problems of individual students, well-designed CBT can adapt to the demonstrated weaknesses of individual trainees. Well designed CBT can sense patterns in trainee responses which signify mastering and/or problems, and can be programmed to present remedial material in response to those problems.

11. The Need for Instructors Can Be Minimized. CBT is written to assume the primary instructor's role in training material delivery. In addition, applying "expert systems" techniques to make CBT adapative further reduces the instructor need. While it is unlikely that programming of training materials will be complete enough to perform all appropriate diagnostics, as well as clarification and explanation, good CBT can assume much of the traditional instructor load.

A Training System Functional Description

Overview

A training system can be thought of as having two major versions: an authoring version to produce and test courseware and a playback version to deliver courses. From a hardware and software perspective, the playback version is a subset of the authoring version: the authoring version must allow the trainer to play back courses in order to test them, but there is no need for the playback version to provide the facilities to author new courses. In general, the hardware for an authoring version is considerably more expensive than the hardware for a playback version. In the ASAS/ENSCE application, it is likely that many playback versions will be needed, but relatively fewer authoring versions. For this reason, we will distinguish between hardware that is needed for the playback version and that which is needed only for the authoring version.

Figure 2-1 presents a list of the major hardware and software subsystems and components for an ASAS/ENSCE training system. The subsystems and components marked with "A" are only needed for the authoring version. The subsystems and components marked with "P&A" are needed for both the authoring and playback versions. The subsystem functions, components, and performance and capability issues are described in the following subsections. The requirements of the EIDS standard are also addressed.

Computer Subsystem

The computer subsystem executes the software and controls all peripheral devices. The EIDS standard has a 16-bit microprocessor computer subsystem capable of executing interactive courseware with branching, videodisk control, and high-resolution graphics. The EIDS standard calls for a minimum of 256 kilobytes (KB) of random-access memory (RAM) with capability for expansion to 512KB, keyboard interface, serial and parallel ports, and expansion slots for above-board memory and other special-purpose interface boards.

The processor is the central processing unit. The bus provides communications among the processor and other boards added to the basic computer subsystem. The expansion slots permit other special-purpose boards to be added to the training system. The performance parameters of the processor are the instruction cycle rate and the word size. The performance parameters of the bus backplane are the number of expansion slots and the word size of the bus. The performance parameter of the RAM is the amount of memory.

ROM is read-only memory containing software for input and output (I/O) routines available to applications software. This software includes the basic I/O system (BIOS), i.e., algorithms and device drivers for graphics cards and software drivers for other I/O devices. A

COMPUTER SUBSYSTEM (P&A)
- Processor and Bus Backplane
- RAM
- ROM with Basic I/O System
- Serial and Parallel Interfaces
- Keyboard Interface and Clock
- Operating System Software

COURSEWARE AUTHORING SUBSYSTEM
- Courseware Playback Software (P&A)
- Courseware Authoring Software (A)

EXTERNAL COMMUNICATION SUBSYSTEM (P&A)
- Communications Card
- Communications Software

MAGNETIC MEDIA MASS STORAGE SUBSYSTEM (P&A)
- Floppy Disk Drive and Controller
- Fixed Disk Drive and Controller

NETWORKING SUBSYSTEM (P&A)
- Network Controller Boards
- Networking Software

OPTICAL DISK SUBSYSTEM (P&A)
- Laser Disk Drive
- Laser Disk Controller Board
- Audio/Digital Data Decoding Board
- Driver Software

VIDEO DISPLAY I/O SUBSYSTEM (P&A)
- Monitor
- Video Display Controller
- Touchscreen, Lightpen, and Other Input Devices
- Special I/O Software

AUDIO/VIDEO RECORDING SUBSYSTEM (A)
- Video Camera
- Video Tape Recorders

IMAGE SCANNING SUBSYSTEM (A)
- Image Scanner
- Interface Board
- Digital Image Manipulation Software

DISK PRE-MASTERING SUBSYSTEM (A)
- Video Tape Controller
- Video Input Port
- Audio/Digital Data Encoding Board
- Mastering Software

SOFTWARE DEVELOPMENT/ TRANSPORTATION SUBSYSTEM (A)
- Editor Software
- Compiler Software
- Data File Transfer Software

Figure 2-1. Subsystems and Components

design issue is the specific device supported by the ROM instructions, and the compatibility with extension BIOS found on other cards.

The serial and parallel interfaces are ports for communication with external devices using standard protocols. The keyboard interface enables a keyboard to function with the computer under software control. The clock is a battery powered clock that remains on even when the computer is off, enabling the computer to have the correct time. The operating system provides file handling, task scheduling, interrupt processing, and device driver services to applications software.

Courseware Authoring Subsystem

The courseware authoring subsystem consists of two components: playback software and authoring software. The authoring software allows the trainer to design and implement courses integrating text, graphics, still video, audio, and action audio/video, as well as performing testing, branching, and record keeping. The playback software executes courses written with the authoring software and actually accesses the various peripheral devices. Compatibility of the courseware authoring system with the hardware, operating system, BIOS, and any software to be linked to the courseware is essential. The EIDS standard calls for playback software that presents feedback to the users, guides users through the session, manages the time and order of presentation, instruction, and test sequences, calculates and preserves student performance records, and plays back video, text, and graphics including both action video and still video with compressed audio.

External Communication Subsystem

The external communication subsystem permits communication with other computer systems such as ASAS/ENSCE workstations. Communications software is needed to encode, transmit, and decode messages using the communications protocols appropriate to the external computer system. Special communications boards may be needed for ASAS/ENSCE communication, depending on the communications hardware and software of the ASAS/ENSCE. The EIDS standard calls for the capability to expand to handle external communications.

Magnetic Media Mass Storage Subsystem

The magnetic media mass storage subsystem provides a medium to store and retrieve data, e.g., student records during training sessions or courseware during authoring sessions. This capability can be provided by either floppy disks or fixed disks. Both require disk drives and controller hardware. Hard disks have greater speed and storage capacity and typically use a small computer standard interface (SCSI) controller board. The EIDS standard has no specific requirement for data storage media other than the videodisk.

Networking Subsystem

The networking subsystem supports communications among multiple training suites on a local area net. This capability might be used for team training. The EIDS standard calls for the capability to expand to have network interface and protocol boards.

Optical Disk Subsystem

The optical disk subsystem retrieves analog data (action and still videos, and audio) from the optical disk under computer software control. Some hardware also allows digital data to be permanently stored on and retrieved from the optical disk. The EIDS standard calls for a laser optical disk capable of storing video, still-frame audio, and digital data. It is to be capable of retrieving video frames randomly or in sequential order. It should be capable of a minimum of ten seconds of compressed audio per still frame. It must be capable of holding 54,000 video frames per side of the disk, or 72 hours of audio. It must be capable of fast search, slow motion, normal play, and single frame stepping in both forward and reverse.

The laser videodisk player retrieves information from the laser disk. It retrieves video frames in random and sequential order. The laser-disk controller board enables the computer to control the retrieval of information from the laser disk player. A separate board is not needed if controller functions are included elsewhere in the hardware.

The audio/digital data recovery board allows sound-over-still audio and digital data to be retrieved from the same optical disk that is used to retrieve video data. Most optical disk subsystems can use the optical disk for either digital or video data, but not both, in which case a hard disk is needed to store digital data (i.e., program data and digitized audio). Separate storage of audio is needed to replay continuous audio over a still video image.

Video I/O Subsystem

The video I/O subsystem provides for the display of action and still video images, text overlays, graphics, and input relative to the screen image. The EIDS standard calls for the ability to switch between text and graphics, and to overlay text or graphics on a video image. It calls for a minimum graphic pixel resolution of 640 horizontal (H) pixels x 400 vertical (V) lines with 16 color contrast. It also calls for support of input devices such as touch screen, light pen, track ball, and mouse.

The monitor displays the video image. Some training systems use one monitor for display of all information; other systems use one monitor for display of video and a second monitor for display of text and

graphics. There is a wide variety of types of monitors. Digital monitors have limited contrast and pixel resolution (e.g., up to 16 simultaneous colors and pixel density of 640H x 400V). Analog monitors have continuous contrast resolution, limited only by the output capabilities of the controller board, and are available with pixel densities up to 1280H x 1024V.

The video display controller board translates video signals and digital data into outputs to the monitor. The controller is responsible for text and graphic overlays and for interpreting light-pen and touch-screen inputs. The controller board typically has ROM containing extended BIOS to enable the operating system and other software to make use of the controller board in different modes (for software use). BIOS routines must be provided for use by the operating system and other software to make use of the video graphics controller capabilities. The controller board may provide other capabilities such as game ports, and video signal digitizing.

Touchscreens, lightpens, trackballs, and other such devices allow for input of positional data, i.e., position relative to the image on the display. Touchscreens require a modification of the monitor; the other devices are simple add-ons which interface through a game port on the video controller card.

Audio/Video Recording Subsystem

The audio/video recording subsystem supports the recording and editing of audio sequences, action video, and still video. The minimal components are a video camera and two video tape recorders (for editing). The audio and video data are transferred to disk storage by the disk pre-mastering subsystem. The EIDS standard does not call out specific requirements for an audio/video recording subsystem, although the requirement is implicit in the requirement to integrate video into courses.

Image Scanning Subsystem

Image scanning digitizes hardcopy pictures (e.g., maps and photographs) for use in a course. The subsystem components are a scanner, a controller card, and software to manipulate the digitized image. Issues in scanner performance are the maximum picture size, the number of dots per inch, and the number of levels of contrast. High-resolution scanners can achieve photographic quality. Scanners interface with custom or standard boards. Image manipulation software for some high-resolution scanners must be custom written, while others are designed to work with off-the-shelf software. The EIDS standard does not call for an image scanning capability.

Disk Pre-Mastering Subsystem

The disk pre-mastering subsystem puts the analog and digital data on the optical disk so that the disk can be used as a master for playback stations. The EIDS standard does not call out specific requirements for a disk pre-mastering subsystem, although the requirement is implicit in the requirement to integrate video into courses.

The pre-mastering subsystem requires a controller for the videotape player and appropriate BIOS software. It also requires a board and BIOS to encode audio and digital data on the optical disk, or to digitize audio data for storage on a hard disk. Finally, it requires software to create the master disks.

Software Development/Transportation Subsystem

The software development/transportation subsystem provides support for programmers to transfer portions of the ASAS/ENSCE operational software to the training system. The ASAS/ENSCE software has not yet been fully developed, therefore it is premature to conclude anything about its transportability to computers with different operating systems and hardware configurations. It is likely, however, that the ASAS/ENSCE software will make use of unique aspects of the ASAS/ENSCE distributed hardware and operating system. Even if the computer subsystems are the same, the additional boards in the system configuration will be different. Therefore, it is likely that the software will have to undergo some modification to run on the training system hardware. Suitable editors and compilers will be needed to transport the software. Additionally, special purpose routines to transfer data files may be needed. These considerations do not address security issues. The EIDS standard does not call for the capability to transport software from operational systems.

Desired Training System Characteristics

This subsection describes CBT system characteristics desired for ASAS/ENSCE training. These are not characteristics of CBT systems in general, but rather are considerations specific to the ASAS/ENSCE application. They are derived from JTFPMO briefings and discussions with JTFPMO personnel. While we do not claim that the considerations described in this section are complete and comprehensive, they do address the major JTFPMO training concerns as we understand them.

The desired characteristics are organized into the following five categories:

1. Who is trained.
2. What is trained.
3. How training is accomplished.

4. Where training is performed.
5. When training is needed.

Who is Trained

The CBT system must be capable of providing training to ASAS/ENSCE operators, both individually and collectively. While individual training can be accomplished on single-student training stations, collective training in team tasks requires simultaneous coordinated training over a network of training stations.

In addition to training operators, the CBT system must be capable of providing training for maintainers, CBT courseware developers, and training managers. While the operators may benefit from CBT embedded in the operational equipment, the other groups of trainees have no such need and for them stand-alone training is sufficient.

What is Trained

The CBT system should be capable of delivering both initial and sustainment training. It should be able to provide both procedural and conceptual training.

Operator training should include training in ASAS/ENSCE procedures, display symbology, and reporting, i.e., to use the ASAS/ENSCE functions, to understand the displays and formats, and to utilize the information and capabilities to produce intelligence information.

Maintainer training should include familiarization with the ASAS/ENSCE hardware configuration and diagnostic and replacement procedures and equipment.

Training of CBT developers and training managers should include instruction in methods and objectives of courseware and training program design as well as techniques and procedures for using CBT tools.

How Training is Accomplished

Interactive computer-based training is accomplished through a combination of tutorial, demonstration, practice, test, evaluation, recordkeeping, and feedback. It should be able to employ interactive video, digitized images, text and graphic overlays, audio playback, and simulated operations (either simulating interactions with the operational software or using the operational software). The courseware should be able to incorporate digitization and display of hardcopy images (e.g., photographs or maps) with near-photographic quality.

CBT should support appropriate training for each of the tiers of the training concept including basic training, function-specific training, and team training. Beginning, intermediate, and advanced levels

of training should be supported. There is a great emphasis on training in a mission context with simulated operations in both static and dynamic scenarios. CBT will not use operational data, but will instead employ simulated data.

Both stand-alone and embedded CBT are desired. Use of a single authoring system is desired, rather than one authoring system for stand-alone CBT and one for embedded CBT. For courseware that will be run on both stand-alone and embedded systems, one-time authoring is strongly desired. The intent is not to burden the CBT developers with having to use several authoring languages.

The CBT system should employ NDI equipment and systems to reduce cost, risk, and delay. At the same time it is desirable that embedded CBT make efficient use of PAWS equipment when it is not being used for operational activities.

Where Training is Performed

CBT will be performed in the field, at duty stations, and in the institution. In the field, the CBT delivery system must be physically disconnected from the rest of the ASAS/ENSCE. This implies that for embedded CBT the delivery system must be disconnected from the rest of the ASAS/ENSCE suite before going into training mode. Other modifications to the PAWS such as loading optical disks with training data and courseware or changing terminals can be done at this time.

PAWS equipment may not be available at the institution and duty stations. Therefore stand-alone CBT should be able to be delivered without a PAWS.

Courseware authoring will take place at the institution, and the facilities to author courses and pre-master optical disks must be available. There should be some facility to enter new data (e.g., new digitized images) in the field, and possibly to modify courseware content as well. Provisions for configuration management and courseware control should be included in training the CBT developers and training managers.

When Training is Needed

CBT is desired for each of the releases, R1 through R5. CBT is considered essential beginning with R2. To support the releases with CBT the CBT system configuration must be selected, the CBT hardware and software must be procured, and the courseware must be authored. Working backwards from the R1 release date, there is very little time for configuration selection and hardware and software procurement. These considerations favor the initial fielding of a stand-alone capability based on NDI hardware and software.

Development of an embedded CBT capability will require interaction between the ASAS/ENSCE designers and the CBT system designers. At a minimum, the CBT system designers and courseware authors will need to have early access to selected information about the ASAS/ENSCE design and operation. Depending on the approach selected to provide embedded CBT, the CBT system designers may have to impose constraints or requirements on the ASAS/ENSCE software design. During the development of CBT courseware, the authors are likely to suggest modifications to ASAS/ENSCE software to improve the operation and human interface. A mechanism needs to be provided for interaction between the training developers and operational software developers.

SECTION 3

ISSUES

This section addresses five major issues in the design, acquisition, and implementation of a CBT system for ASAS/ENSCE. We describe the issues, alternative approaches, and factors that favor one alternative over another. In Section 6 we present our best resolution of these issues and our resulting recommendations.

All of these issues are important and are closely interrelated: the resolution of one issue will have implications for the resolution of the other issues. There is no clear priority among the issues and there is no significance to the order of presentation.

Stand-Alone CBT Versus Embedded CBT

Stand-alone CBT is delivered on equipment that is not part of the ASAS/ENSCE. Embedded CBT is delivered using the ASAS/ENSCE PAWS. Either stand-alone CBT, embedded CBT, or a combination of the two can be used for ASAS/ENSCE. The issue is whether to use stand-alone CBT, embedded CBT, or some combination, and if so, how to combine them.

Stand-alone and embedded CBT can be combined in several different ways. They can be used for different training content, e.g., each technique can be used to train material for which it is most appropriate. They can be used at different locations, e.g., stand-alone CBT can be used in the institution and at the duty station where PAWSs are not available, and embedded CBT is used in the field where PAWS are available. They can be used at different times in the ASAS/ENSCE development, e.g., stand-alone CBT can be used initially, then later as the ASAS/ENSCE program is completed embedded CBT can be introduced.

Stand-alone CBT is most appropriate for training people who do not have access to embedded CBT on a PAWS (i.e., at the duty station and at the institution) and for training personnel who will not be operating the PAWS (e.g., maintainers, training managers, and courseware developers). Embedded CBT is most appropriate for training operators in their spare time on the PAWS. For these reasons, we recommend comprehensive stand-alone CBT and selective embedded CBT for operators in the field.

Stand-alone CBT has the advantages of low cost, low risk, portability, not requiring a PAWS, and suitability for a wide range of training. It has the potential disadvantage of not being able to directly employ software from the operational ASAS/ENSCE for operator practice, and must rely on simulated operations and interactions.

Embedded CBT has the advantages of making efficient use of PAWS equipment and operator time in the field, and of providing practice on the operational hardware. It has the potential disadvantage of requiring that some modifications be made to the PAWS to support embedded CBT. The modifications could include both hardware changes and software changes.

Combining stand-alone and embedded CBT introduces the potential problem of duplicate authoring for courses that would run on both systems. It is undesirable to author the same course twice, once for each system. It is desirable to have only one authoring system for both delivery systems to minimize the burden on the courseware developers. There are several design configurations that use the same authoring system for both embedded and stand-alone CBT (see Section 4). It is also conceivable that two separate authoring systems would be acceptable if a translator were developed to automatically translate courseware for stand-alone CBT into courseware for embedded CBT and vice versa.

Timing of the Design Commitment

To provide timely CBT in phase with the ASAS/ENSCE software releases, IOC, and fielding, the design commitment must be made with sufficient lead time for CBT system procurement and courseware development. Within this constraint, there are arguments in favor of early design commitment and opposing arguments in favor of deferred design commitment.

Early CBT design commitment permits early development of training materials. The courseware developers are likely to gain insights into potential training and operational difficulties with the emerging ASAS/ENSCE software design. They will be in a position to provide feedback and suggestions regarding the user interface. The earlier these suggestions are made, the more likely it is that they can be incorporated into the ASAS/ENSCE design.

If the CBT system involves an element of embedded CBT, then some modifications of the PAWS hardware and software may be necessary to support the embedded CBT. These modifications must be specified early on so that they can be incorporated into the ASAS/ENSCE design. Some approaches to embedded CBT will require more modifications than others, and for some approaches the modifications will be trivial. For example, approaches in which the courseware executes on the PAWS MicroVAX and incorporates elements of the operational software will require significant modifications whereas approaches that "strap on" additional hardware for training will require minimal modifications. If the CBT design can not have timely impact on the ASAS/ENSCE design, then some CBT alternatives will be infeasible.

If the design commitment is made later rather than earlier, the ASAS/ENSCE design will be more complete and stable, and there will be better information with which to define the training requirements. This means that there will be lower risk that the CBT will be unable to support the training requirements. Early CBT design commitment based on incomplete or evolving training requirements runs the risk of committing to an inadequate design and the risk of committing to an expensive growth capability to compensate for uncertainty in the requirements.

The CBT design commitment can be made in stages with early commitment to a stand-alone approach and later commitment to an embedded approach. This approach permits early acquisition of CBT capability while deferring full commitment until the training requirements and operational system are more completely defined. Nonetheless, delayed commitment to an embedded CBT approach narrows the range of options since it becomes more difficult to influence ASAS/ENSCE design.

Use of Operational Software

There are several potential uses of the ASAS/ENSCE operational software in an embedded CBT system, and several different ways in which the operational software can be used. We understand that the use of operational data for training is not acceptable, but that training data in the same format as operational data can be used.

The operational software consists of system software and applications software. System software refers to the operating system and utility programs such as DBMS and networking software that compose the application software environment. Applications software refers to software and database designs specific to the ASAS/ENSCE application including software to implement intelligence algorithms and procedures.

It would be natural for an embedded CBT system that executes the courseware on the PAWS MicroVAX to use the operational system software. This avoids duplication of effort to provide the software environment and avoids having to load a new operating system and utilities to run the courseware. This would constrain the selection or design of the authoring language to be compatible with the operational software environment. If the courseware is not run on the PAWS (as in the strap-on device approach) this is not an issue.

One aspect of CBT is to provide practice for the operators. Stand-alone CBT accomplishes this by simulating the PAWS operations and interactions. Embedded CBT offers the possibility of employing the operational applications software under courseware control. The training courseware provides the training database and generates external input messages and responses.

The principal advantages of employing the applications software are that (1) separate simulations do not have to be written, and (2) there is complete fidelity between the training software and the operational software. These advantages will be most significant in complex procedures, full-task training, and especially in collective team training.

The principal disadvantages of using the applications software are that (1) it can be difficult to integrate with courseware and involves high risk of failure, (2) the courseware may have to be change each time the application software is changed even if there is no change in the user interface, (3) it requires close coordination between the courseware developers and the applications software developers, and (4) it may require the courseware developers to impose software design requirements on the applications developers.

Recent advances in the development of authoring languages and systems suggest an approach that alleviates the above mentioned problems with utilizing the applications software as a part of the courseware. There are several authoring packages on the market that purport to allow for the development of training that utilizes operational software without any detrimental effect to the application. The training is designed to run "concurrently" with the operational software. In other words, as the student runs his application, training windows would be overlaid onto the application. These windows would contain instruction and/or feedback. As he progresses through his task, the student's input would be recorded and appropriate feedback would be presented to him, either immediately, deferred, or on demand.

Of the authoring systems that have concurrent programming as one of their capabilities, one seems to stand out as being potentially usable for ASAS/ENSCE training development. This system is the Electronic Publishing System (TM) (EPS). A review of EPS appears in Appendix B. This system, developed and marketed by Cdex-Intelligance Corporation, allows for courseware authoring on the EIDS or the PAWS microVAX, and is transportable between any systems that support either "C" or PASCAL. Courseware can include both IVD-based lessons and lessons that run concurrently for the operational software. Although EPS was not field-tested nor seen in operation by the authors of this report, it was thoroughly reviewed for an effort sponsored by the Naval Aviation Logistics Center to select a system for the development of concurrent (embedded) training (see Duncan, et al., (1987).[2]

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[2] Duncan, L. D., Halsey, P. J., Handler, G. H., MacGregor, D. G., & Sparks, S. G. (1987). Recommended CAI approach for NALDA system. Technical Paper ORNL-6340 for U.S. DOE., Oak Ridge, TN: Oak Ridge National Laboratory.

There is a third disadvantage to using the operational software as an element of the training. This problem is concerned with the security requirements for the system, in that trainees should not be exposed to classified information. This problem may be overcome by employing data sets during training that contain realistic, but inaccurate information. These data could exist as database and text files that are accessed by the trainee from an application when in the ET mode.

There are two distinctly different approaches to using the application software in embedded CBT. One approach replaces the PAWS terminals with strap-on devices. The other approach is to fully embed the training into the PAWS microVAX.

Advantages of using a strap-on device is that the selected device can be the same as the delivery system for non-embedded training. The courseware could be developed using the same authoring system as used for the stand-alone configuration. There would be an overlap in the development of training for the stand-alone configuration and the embedded system, as well as courseware designed specifically to use the operational software. The courseware would then be resident on the strap-on device and would run concurrently with the operational software that resides on the microVAX when it is appropriate to do so. A strap-on device would also allow for the presentation of IVD-based training developed for the stand-alone configuration.

The major disadvantage of using a strap-on device for courseware delivery is that problems might arise during the use of training in the unit. The primary problem foreseen is that the strap-on devices must be stored when not in use, and when the strap-on devices are in use, the space within the enclave may become very restricted. The process of connecting the strap-on device to the microVAX may become an onerous task because it is a necessary requirement, and personnel may become less likely to take advantage of the training because of this inconvenience.

Fully embedding the training into the PAWS alleviates the spatial difficulties that might arise during unit training. However, fully embedded training has its own drawbacks. First of all, the disk storage available on the microVAX could limit the amount of courseware that resides on the system. The second problem is that unless training is developed with an authoring system that allows transportability between configurations, duplication of effort courseware development for the stand-alone and the embedded systems would probably be necessary. Third, unless the PAWS incorporates a video disk player, as was proposed in an early PAWS design, IVD-based training could not be a component of the training system.

Digitizers: Image Scanners and Video Grabbers

Much of the ASAS/ENSCE analyst's work employs maps--situation maps, overlays, and topographic maps. It is not clear whether or not there is any need for ASAS/ENSCE analysts to examine photographic images such as of the actual terrain, troops, or targets. Analysis of photographic and imagery intelligence is not normally the job of the ASAS/ENSCE analyst.

The CBT system must be able to display maps and possibly other images on the video display as part of normal training. To do so, the display data must be entered into the CBT system. Digitizers provide the capability to enter this data automatically. It is not clear whether or not it is needful and feasible to ship these data to the operational ASAS/ENSCE.

Optical scanners and video grabbers are devices that convert pictures into digital representations that can be manipulated by computer and presented on video displays. Optical scanners digitize hardcopy (i.e., paper) pictures. Video grabbers digitize frames from video cameras, video tape players, and similar devices. It is not clear whether optical scanners, video grabbers, or both are needed for courseware authoring.

It is important to note that digitized maps are not the same thing as digital maps. Digitized maps are simply digitized images of maps. Conceptually, a grid is overlayed onto the map image. Each cell in the grid is assigned a number representing the color or intensity of the image at that point. Roads, coordination lines, and other objects do not exist as such in the digitized map. The software cannot identify, search, or manipulate units, axes of advance, or other objects.

Digital maps are digital representations of the information used to construct the map. Digital maps consist of data describing what objects are on the map, where they are, and other properties of the object. Digital maps employ software to create images from these data and to select and manipulate the map objects. At the present time, the only way to create a digital map from a hardcopy is to do so manually. Digitizers cannot be used for this purpose.

The resolution of digitizers ranges from coarse to better than the human eye. The following questions about resolution need clarification:

1. What resolution is needed?

2. Is there any need to digitize images at a higher resolution than can be displayed on the PAWS display devices?

3. Is there any need, for training purposes, to have higher display resolution on the stand-alone CBT system than on the PAWS display?

Authoring in the Field

Courseware authoring will take place at the institution. There may also be a need for an authoring capability in the field. Courseware authoring or modification in the field may be needed to tailor or create courses for specific situations of units in the field. If the digitizer in the CBT system is intended to be used to enter data into ASAS/ENSCE in the field, then most of the capabilities of an authoring station will be needed in the field. However distributed, courseware authoring can lead to problems in the management and control of courseware that would be avoided by centralization of authoring at the institution.

Whether or not courseware authoring takes place in the field has implications for the number of authoring stations that must be purchased and for the number of courseware developers that need to be trained. If it is decided that partial field-authoring capability is needed, but that full field-authoring capability should not be provided, then two versions of the authoring station will be needed--one for the institution and one for the field. This will increase the total system cost.

SECTION 4

ALTERNATIVE DESIGN CONFIGURATIONS

The purpose of this section is to compare and contrast alternative ASAS/ENSCE CBT system design configurations. This section addresses both the process of design and nature of alternative configurations for stand-alone and embedded CBT.

This section does not address specific designs, design details, or the details of alternative hardware and software components. Some details, based on the results of market surveys, are presented in the technical appendices. Appendix A presents the results of a market survey of commercially available CBT systems. Selected key subsystems and components are surveyed in Appendices B, C, and D: authoring languages, image scanners, and high-resolution graphics boards and monitors. Appendix E addresses specific issues in upgrading the Matrox EIDS suite for high-resolution image scanning and graphics.

Our approach was to generate several alternative configurations, then to compare and contrast them on the basis of the desired characteristics and issues described in Section 2. Several considerations governed our construction of alternatives. CBT systems consist of a large number of interrelated subsystems and components that must be designed to work together and carefully interfaced to produce a working system. Therefore we proposed total CBT system design approaches, not merely discussions of individual items of hardware or software. Each alternative represents a technologically feasible means of providing effective stand-alone and embedded CBT for ASAS/ENSCE. The alternatives represent both developmental and non-developmental systems, specifically PAWS-based and EIDS-based alternatives. Finally, we incorporated high-resolution optical scanning and display capabilities.

We have constructed three alternative design approaches. As illustrated in Figure 4-1, each approach supports both stand-alone and embedded training, and has options for specific subsystems. These approaches do not exhaust the range of possible alternatives, however they do represent significant design variations and are all capable of meeting the CBT need. The design approaches are described and compared below.

	STAND-ALONE CBT SYSTEM	EMBEDDED CBT SYSTEM
Option 1: Modified PAWS	Modified PAWS	Modified PAWS
Option 2: EIDS/Modified PAWS	Upgraded EIDS	Modified PAWS
Option 3: EIDS-PAWS Hybrid	Upgraded EIDS	EIDS-PAWS Hybrid

Figure 4-1. Alternative Design Approaches

Alternatives

Modified PAWS

The modified PAWS approach uses different configurations for stand-alone and embedded CBT systems, both built by modifying the PAWS. The stand-alone CBT modified PAWS is essentially a "stripped down" version of the embedded CBT modified PAWS: PAWS hardware and software not needed for stand-alone CBT can be removed. For example, ASAS/ENSCE communications cards may not be needed for stand-alone CBT.

This approach is likely to involve a significant software development effort for courseware authoring and playback/delivery on the modified PAWS hardware. Since we are unfamiliar with the details of the use of special features of the PAWS hardware by the PAWS software, we are unable to assess the difficulty of the software modifications.

For embedded CBT, the PAWS needs to be upgraded to incorporate an image scanner. Image scanning capability is not needed at the playback/delivery stations, only at the authoring stations. This means that an interface card for the scanner must be plugged into the bus of the PAWS MicroVAX computer. A slot on the bus must either be available or be made available. Software to manipulate the image must be available. The authoring stations must also have the hardware and software to write to the optical disk to store the digitized images, and must store them in the same format as they will be read by software in the playback system. If there is a need to transfer the digitized images to the ASAS/ENSCE database, then there must be software to send and receive the data.

The playback/delivery stations must have software to display the digitized images during courseware execution. It must be able to read digitized image data from the optical disk. If high-resolution image display is already a feature of the PAWS, then no modifications to the video display subsystem need to be made for near-photographic reproduction of the scanned images. If the video display subsystem does not have adequate resolution for near-photographic reproduction, then the need for high-resolution digitizing is questionable.

The authoring station must have software with which to author the courseware and the playback/delivery stations must have the software to execute the courseware. If networking of playback/delivery stations for team training is desirable, then the authoring software must support networking and the playback/delivery software must be able to use the PAWS networking hardware and software (or else additional networking hardware and software must be provided). If the courseware is to employ portions of the ASAS/ENSCE operational software, then the operational software must be designed so that it can be executed as part of a course.

EIDS/Modified PAWS

The EIDS/modified PAWS approach uses an upgraded Matrox EIDS suite for the stand-alone CBT system and a modified PAWS for the embedded CBT system. The modified PAWS for embedded CBT is essentially the same as in the modified PAWS approach. A nondevelopment item (NDI) CBT system such as EIDS is used for stand-alone CBT. Authoring can be done on either system. Single authoring of courseware can be accomplished by building a translator to automatically translate courseware authored on one system so that it may run on the other system. Different video disk formats would require separate mastering of the optical disks.

Of the CBT systems reviewed in our market survey, the Matrox EIDS appeared to be the most suitable for upgrade to incorporate high-resolution image scanning, and had the greatest flexibility for other alterations. For these reasons, we have chosen the Matrox EIDS as the example NDI CBT system.

The Matrox EIDS would have to be upgraded to incorporate high resolution image scanning and display. Specific changes required to upgrade the Matrox EIDS are described in Appendix E.

EIDS-PAWS Hybrid

The EIDS-PAWS hybrid approach uses the Matrox EIDS suite for the stand-alone CBT system and an EIDS-PAWS hybrid for the embedded CBT system. The stand-alone system is the same as the stand-alone system for the EIDS/modified PAWS alternative. The hybrid for embedded CBT connects stand-alone Matrox EIDS playback/delivery stations as terminals to the PAWS MicroVAX, as illustrated in Figure 4-2.

A PAWS is converted to training mode by unplugging or switching off the standard terminals and connecting the Matrox EIDS stations. The courseware is executed on the Matrox EIDS stations, using the Matrox optical disk system. ASAS/ENSCE software is executed on the MicroVAX, and interfaces with the courseware by acting as a terminal. Networking for team training is handled through the PAWS networking hardware and software. The only special software that needs to be developed for this approach is software to run on the Matrox EIDS to generate and interpret ASAS/ENSCE terminal I/O data.

Comparison

The three alternatives have different advantages and disadvantages. The table in Figure 4-3 lists the principal advantages and disadvantages of each approach. The remainder of this section provides a point-by-point comparison of the three approaches against key desired characteristics of ASAS/ENSCE CBT.

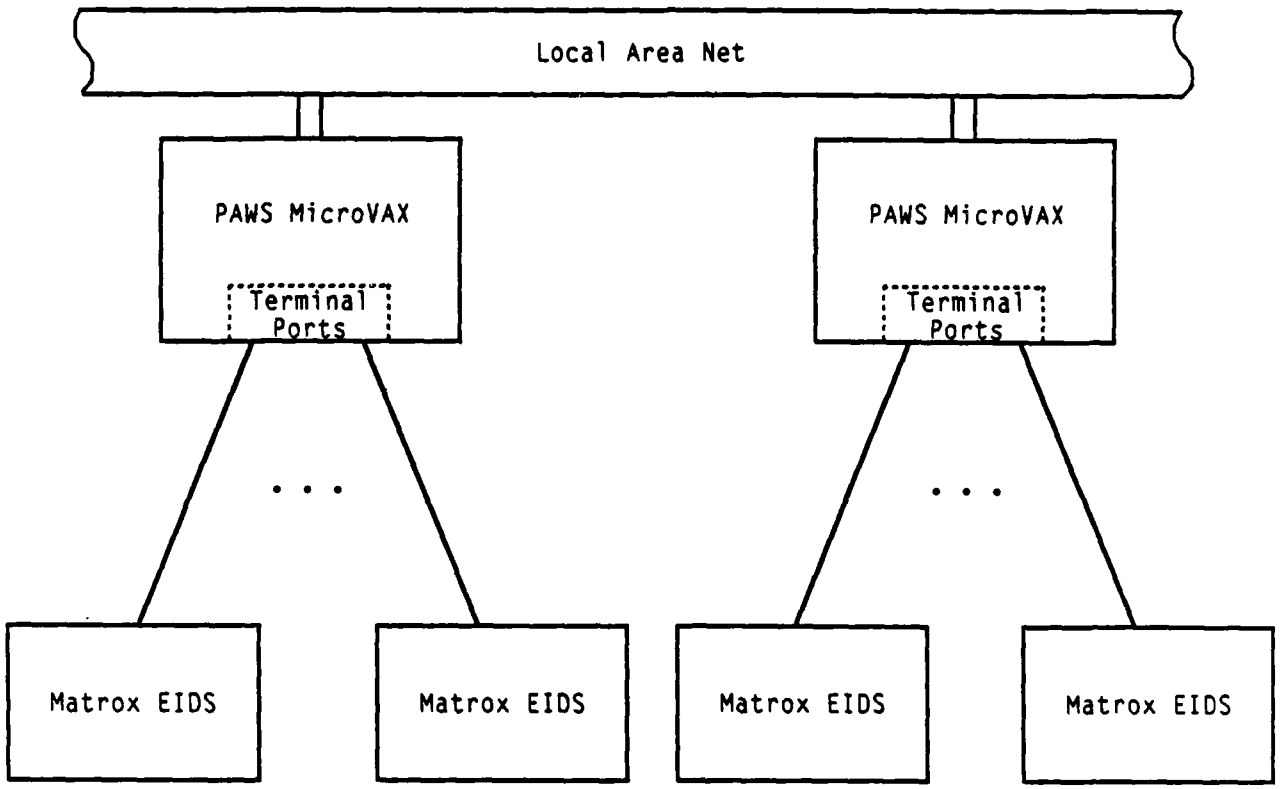


Figure 4-2. EIDS-PAWS Hybrid

Approach	Advantages	Disadvantages
Modified PAWS	• Virtually the same system for stand-alone and embedded CBT • True single-authoring • Full use of PAWS for training	• PAWS required for stand-alone training • Impact on PAWS Design • Unlikely that a training system can be ready for early releases • Risky software development for authoring • Difficult interface with operational software
EIDS/Modified PAWS	• Stand-alone system for early training, PAWS not required • Full use of PAWS for embedded training	• Risky software development for courseware translation, or duplicate authoring • Impact on PAWS design • Stand-alone training not on operational hardware • Difficult interface with operational software
EIDS-PAWS Hybrid	• Stand-alone system for early training • Partial use of PAWS for embedded training • True single-authoring • Virtually the same system for stand-alone and embedded training • Easy interface with operational software	• Training stations must be moved into PAWS for embedded CBT • Stand-alone training not on operational hardware

Figure 4-3. Principal Advantages and Disadvantages of Each Approach

Who is Trained

All three approaches are suitable to training operators (individually and collectively), maintainers, CBT developers, and training managers. The stand-alone EIDS system is more appropriate than the modified PAWS for all except the operators who may benefit by training on the operational hardware.

It is not clear which approach is best for the operators. Good comprehensive courseware on the EIDS-PAWS hybrid is better than poor or incomplete courseware on a modified PAWS. It will be less risky and easier to develop good courseware for the EIDS-PAWS hybrid.

What is Trained

All three approaches are capable of training procedures, symbology, reporting, and CBT development.

How Training is Accomplished

All three approaches can provide computer managed instruction for the five tiers of training with image digitization and overlays. Because it is probably the most effective means of using operational software in training, the EIDS-PAWS hybrid probably offers the most favorable environment for training the higher tiers. Both the modified PAWS and EIDS-PAWS hybrid require only one authoring system, while the EIDS/modified PAWS employs a translator. The modified PAWS and EIDS/modified PAWS make efficient use of ASAS/ENSCE equipment for embedded CBT, while the EIDS-PAWS hybrid makes only partial use of the PAWS.

ASAS/ENSCE operational software can be used in embedded CBT with the modified PAWS provided that the software is designed or modified for such use. The EIDS-PAWS hybrid can use the operational software without changes. The operational software can be used for stand-alone training only with the modified PAWS approach, and then provided that the necessary modifications are made. The operational software can be simulated on the EIDS system for stand-alone training.

Where Training is Performed

All approaches can support training in the field, at duty stations, and in the institution. However, the modified PAWS approach requires that PAWSs be available at duty stations and in the institution. If stand-alone systems are used in the EIDS/modified PAWS for duty station and institutional training, then courseware translation or separate authoring will be a continuing problem. The EIDS-PAWS hybrid is the most versatile approach.

When Training is Needed

Early stand-alone training can be provided by beginning with an EIDS CBT system. Either the EIDS/modified PAWS or EIDS-PAWS hybrid can be developed from this starting point. The modified PAWS will be very late in coming on line. The EIDS-PAWS hybrid offers the fastest path to embedded CBT and CBT for the higher tiers and later releases. The modified PAWS will take much longer.

SECTION 5

ACQUISITION STRATEGIES

In terms of a longer term strategy to implement training and embedded training for ASAS, the Army is faced with a number of uncertainties. First, the development of the system is phased with the eventual end item Release 5 scheduled for sometime in the future. It can be expected that the software of the system will change and evolve as Releases are provided to the Intelligence Center and School and to the units in the field.

Second, computer technology is continually advancing. As a consequence, any decision regarding CBT procurement must deal with the problem of buying current equipment now, or delaying the procurement recognizing that in the near term and farther in the future, it will be possible to procure today's capability for less funds, or significantly more capability for the same funds.

The purpose of this section is to address this issue. It first provides a brief overview of the trends in CBT technology, both hardware and software. It then defines and discusses alternative approaches to the decision of when and what to procure.

Trends

New computer hardware and software components and technologies have been developed at an increasing rate over the past five years. This trend is likely to continue for the foreseeable future. This section addresses the issue of potential future hardware and software developments in the near, mid, and long term that might pertain to ASAS/ENSCE training systems.

The near term is considered to be the period of time in which current release plans are realized, and in which current trends continue without change. This period is nominally taken to be the next six months, i.e., until 1988. The mid term is considered to be the period of time in which new developments are begun and reach maturation, in which specific technological trends change, but in which innovation, not invention, governs developments. This period is nominally taken to be from six months to five years in the future, i.e., from 1988 to 1994. The long term is considered to be the period of time in which technological breakthroughs occur and are translated into practical developments. This period is nominally taken to be from five to twenty years in the future, i.e., 1994 to 2007.

The following paragraphs describe the market forces and technological trends governing developments in the near, mid, and long term, predict likely developments in the near, mid, and long term, and address the implications for a total ASAS/ENSCE training system acquisition strategy.

Market Forces and Technological Trends

Near Term. In the near term, companies will release products which are already in the later stages of development including new products as well as new versions and releases of existing products. These products will not perform radically new functions, nor will they employ radically new technologies. The new products will employ current technologies and will resemble existing products.

Companies will be implementing plans to expand market share by releasing look-alikes at lower prices to compete with existing products for which a market has already been established. Many look-alikes will provide enhanced capabilities. There will be increases in the variety of products, marginal increases in capability, and lower costs.

The near-term advances will continue in the same areas in which they have for the past year. Most notably they include high-resolution graphics boards, optical scanners, pictorial database software, compact disk read-only memory (CD ROM), and other narrow thrusts of current innovation. Fewer new developments will be found in areas of recent innovation that have begun to become saturated such as networking and external communications. New areas of innovation are unlikely to emerge in the short term.

The vast majority of the new hardware products will be designed to interface with open-architecture computer subsystems (e.g., the IBM PC and PC AT and the Macintosh II). It is much more difficult for third parties to develop new hardware for closed-architecture subsystems (e.g., the Macintosh and Wicat).

Another area of potential near-term advances involves applications for recently released hardware and special-purpose hardware compatible with new computer subsystems, i.e., products that piggy-back on existing products. Applications software lags behind the hardware technological innovations because software cannot be designed and tested until the hardware is available. Special purpose boards lag behind new computer releases because the boards cannot be designed and tested until the computer is available. For these reasons, systems integration will not take place at the leading edge of technology. The latest technological developments will generally remain incompatible with each other, and with much of the existing hardware and software.

Mid and Long Term. During the mid and long term, companies will continue to develop new products along existing innovation lines, but at a decreasing rate as competition lowers profit margins and as demand strengthens for different advancements. Companies will begin more developments to piggy-back on recently released products to enter new

market niches, and to define market niches by innovating ways to satisfy user demand. In this way users have an opportunity to influence the future. For example, during the course of this project, Matrox asked us to describe our needs for high-resolution graphics for their EIDS suite for consideration in planned design efforts.

Also during the mid and long term, companies will initiate new development efforts to exploit technological breakthroughs. In particular, recent technological breakthroughs will begin to lead to extremely powerful optical scanners and video digitizers. The trend towards specialized processors on extension boards for microcomputers to provide mainframe capabilities for specialized processing (e.g., image processing) will continue. The types of technological breakthroughs and their implications cannot, however, be predicted with any accuracy.

Some companies will move from closed architectures to more open architectures in order to create a greater market (witness Apple's move from the closed architecture of the Macintosh to the more open architecture of the Macintosh II). Some companies will move from open architectures to more closed architectures in order to protect market share (witness IBM's move from the open architecture of the PC to the more closed architecture of the PS/2 family). There is no general trend toward either open or closed architectures.

Potential Advances

Near Term. We expect that a wider variety of high-resolution graphics cards will be released (some of the graphics cards included in our survey have not yet been released). The cards will come down in price and provide more features, such as BIOS for text generation. These cards will be designed for the PC and PC AT computer family. It is unlikely that new high-resolution cards will be released in the near term for the DEC PRO 350 or the Wicat terminal due to their closed architectures, or for the Macintosh II, since the system has only been available for a short time.

More high-resolution, large-screen (19-inch) monitors will be available. More flat monitors with reduced distortion on edges will be released.

We expect that more software compatible with the Matrox EIDS hardware will be released. Wicat is working on adapting its authoring system for Matrox hardware. Other vendors will release software for the EIDS market.

The prices of optical scanners will continue to come down. A low-priced optical scanner for large images (e.g., 14 inches by 17 inches) may be released. A low-priced scanner with more than eight bits for contrast resolution (256 levels) may be released. Improved-quality video digitizers will be available.

More and better software for image manipulation and pictorial databases will be released for microcomputers. Two years ago there was only one pictorial database product for the PC and PC AT market. Today there are half a dozen, although none of them are very good yet.

New versions and releases of software packages will become available that take advantage of high-resolution graphic capabilities. Whether or not any authoring languages will be modified for high-resolution graphics remains to be seen.

Mid and Long Term. In general, the trend towards lower prices, more variety, and smaller systems with more capabilities will continue in the mid and long term. We expect to see more system developments. We expect to see interactive videodisk computer-based training systems built around the Macintosh II computer. We expect to see a new high-resolution EIDS standard emerge (based on the Matrox 1280 board) because of customer demand. New versions of the DEC and Wicat training systems will be produced, possibly with high-resolution graphics and other features.

It is not possible at this time to predict the directions of new technological breakthroughs and trends of innovation in the mid and long term. It is certain that new and unforeseen developments will take place, and these new state-of-the-art components will tend to be incompatible with existing systems. The problems of transporting software will not go away, nor will the problems in integrating different software packages.

Acquisition Strategy

We see three key choices in an acquisition strategy. The first choice is whether to buy and upgrade a nondevelopment item (NDI) training system, or to let a contract to develop one. The second choice is whether to acquire a training system in the near term (i.e., before the ASAS/ ENSCE R1 release), or to wait for the ASAS/ENSCE program to mature and the training requirements to evolve. The third choice is whether to acquire an initial capability and upgrade it as the training requirements evolve, or to acquire an initial capability with the intent to replace it as necessary when the training requirements evolve beyond its capabilities.

Development of a training system will take longer and cost more than upgrading an NDI system, especially if the training requirements change after the contract is let. A contract should be let to develop a training system only if the training requirements can be articulated, if it is projected that no NDI system can be modified to meet the requirements, and if the training system will not be needed in the near term. A development contract should be let only if the training requirements imply that any NDI system would have to undergo major architectural or system-wide changes. If the training requirements

could be met by selectively upgrading subsystems of an NDI system, then procurement and upgrade of an NDI system is preferable.

If a training system is required at the time of the R1 release, then it is necessary to procure a training system in the near term. The training system must be obtained as soon as possible to allow time for the purchase cycle, upgrade, and for courseware development. This implies procurement of an NDI system due to the time lag inherent in a development contract. If the training system is not needed until R2/3 or later, then procurement should be postponed as long as possible to allow the training requirements to evolve.

As the ASAS/ENSCE program matures the training requirements will evolve. We have identified two approaches to handle this. The "growth" approach is to procure an initial system that can be upgraded to meet the immediate training requirement and has maximum capability for further upgrades. The "replacement" approach is to procure an initial system that can be upgraded to meet the immediate training requirement at minimum cost, and to plan on replacing it as the training requirement evolves beyond its capabilities. An actual acquisition can use a compromise between these two pure approaches.

The growth approach makes it easier to incorporate new innovations as they are released, and to provide new capabilities as the requirements become apparent. However, there is a risk that there will be technological breakthroughs or long-term innovations that are incompatible with the original system and cannot be incorporated. There is a risk that at some point the training requirement will have evolved so far that the original system can no longer be upgraded to meet the requirement and must be replaced. Greater stability will be achieved with the growth approach, but with the risk of being stuck with archaic technology.

The replacement approach makes it easier to adapt to radically new technologies or dramatic developments in ASAS/ENSCE and its training requirements. While it may happen that the original system can continue to be upgraded for a while to track the evolving training requirement, periodic replacement should be anticipated. Greater flexibility is achieved with the replacement approach, but at a cost of more frequent disruptions of the training system.

The choice between the growth and replacement approaches depends on the accuracy and completeness with which the training requirements can be articulated, and whether or not an NDI can be upgraded to meet the requirements. If, when it comes time to procure the training system, the training requirements can be well articulated, and if an existing NDI system can be upgraded to meet the projected requirements, then the growth option is preferable. To the extent that either of these conditions are not met, then the replacement option is preferable.

SECTION 6

RECOMMENDATIONS

This section presents the approach recommended for ASAS/ENSCE CBT development. The approach was selected based on an assessment of the CBT capabilities available currently and improvements expected in the future, on the requirements for training, and on the development of both a CBT subsystem and the prime system.

When this study was initiated, considerable emphasis was placed on establishing the state of the art in CBT hardware and software and estimating the increases in capability likely to occur in the future so as to make recommendations as to what and when to procure or develop. Our conclusion is that the state of the art is sufficient to support CBT in either stand-alone or embedded modes provided that the Army is willing to procure the necessary equipment and services to design, implement, and support courseware. (As with most discussions of computer applications, it is clear that capability will increase and costs will decrease in the future.) As a corollary we add that developing fully embedded training will require a significant level of interaction between the training developers and the operational software developers and that some changes to operational system hardware and software can be anticipated if ET is to be accommodated.

The alternative we recommend supports both stand-alone and embedded CBT. We believe this approach is particularly important in this early stage of the ASAS/ENSCE development in terms of providing training, accommodating the need for security, and responding to the development process. It lowers schedule and cost risk and provides a basis for a phased and low-risk transition to full ET should that be desirable in the future. We believe that the problem of developing simulations to run on stand-alone equipment is not a major disadvantage. In fact it may prove beneficial for development of ET on the operational system.

One design constraint was that the training system not make use of operational data. This does not preclude the use of operational software: either the system software or the applications software. Development of a stand-alone CBT system may be able to employ portions of the applications software source code, and will certainly benefit from access to the application software documentation. For team and collective training in an embedded training mode, use of the system software appears to lower cost risks, i.e., use of the ASAS/ENSCE database management system (DBMS) and networking systems in support of courseware simplifies the development process.

It is clear that for certain training requirements a digitizer will be necessary, at least at the authoring stations (which we see as located at the schools). A case can be made for provision of digitization capability at duty stations and in the field, primarily to reduce the turnaround time inherent in tailoring location/threat-dependent material for augmenting the training system. The key issue is level of resolution and the compatibility between that of the PAWS and the stand-alone trainer. We recommend that high resolution be chosen for the stand-alone trainer regardless of that incorporated currently in the PAWS. We base this recommendation on the fact that the system will be used to train cognitive skills other than image recognition and in that training understanding of relationships illustrated only via high resolution will be important.

The decision to provide authoring capability in the field focuses on the scope of capability envisioned. If this scope is extensive, then a commitment must be made to training personnel in courseware development. We believe that adding a requirement of this magnitude to the tasks of ASAS/ENSCE personnel is not reasonable. However, the provision of a restricted structured capability is cost effective.

The most critical issue, in our opinion, is that of timing. We recommend that a stand-alone system be procured immediately and courseware be prepared and implemented via an authoring system. We base this recommendation on a number of factors. First, our experience with four other Army systems (the operational software systems of which are at least an order of magnitude less complex than that of ASAS/ENSCE with delivery schedules less demanding than that of ASAS/ENSCE) suggests that the integration of training and operational systems will require resources and time. Relative to the operational system, both are scarce. Second, based on our analysis of ET requirements for ASAS/ENSCE, we believe it will take time to complete the front-end training analysis necessary to design courseware. Moreover (typical of all systems), this analysis will have to be updated as the ASAS/ENSCE evolves through R1 to R5. Third, we believe that the development and use of courseware for a stand-alone trainer will provide valuable feedback to the system developers. Fourth, we believe that to provide training for R1 and subsequent releases, this approach offers the highest probability of success. Finally, we believe that this approach will permit the development and integration of embedded training to proceed in an evolutionary manner, hardware capabilities notwithstanding. The recommended alternative described below is low risk and accommodates growth in stand-alone and system hardware, software, and training technology.

The EIDS/PAWS Hybrid

As described in Section 4, the EIDS/PAWS Hybrid uses the Matrox EIDS suite for the stand-alone system, upgraded to incorporate high-resolution image scanning and display. It is an off-the-shelf NDI buy

and can support an immediate start on courseware development. It offers the additional advantage of being part of the Army's current family of training systems. The PAWS Hybrid for embedded CBT connects a stand-alone Matrox EIDS playback and delivery station as a terminal to the PAWS MicroVAX. Courseware is executed on the Matrox EIDS stations using the optical disk. ASAS/ENSCE software is executed on the MicroVAX, interfacing with the courseware by acting as a terminal. ASAS/ENSCE system software handles networking for team training; the only software development necessary runs on the Matrox EIDS, generating and interpreting ASAS/ENSCE terminal I/O data.

This approach meets the need for stand-alone and embedded CBT, includes a digitizer, has a single authoring system, and makes use of certain portions of the ASAS/ENSCE system software. Most importantly it offers the lowest risk relative to development and integration, which we believe is a critical factor in this program.

APPENDIX A

CBT SYSTEM SURVEY

APPENDIX A

CBT SYSTEM SURVEY

This appendix presents a comparative description of existing training systems. A general description of each system is presented, as well as a subsystem-by-subsystem detailed description. The training systems are produced by:

1. Matrox Electronic Systems, Limited;
2. Wicat Systems;
3. Digital Equipment Corporation (DEC); and
4. Applied Interactive Technologies (AIT), Incorporated.

Points of contact for these training system developers are provided in Figure A-1.

We have made no attempt to describe training systems that could be assembled from component parts, and have restricted our scope to commercially available training systems. Because of the many and complex interface issues, extensive work with the hardware and software would be required to identify groups of compatible components which could be integrated to produce a training system.

Matrox. Matrox holds the Army contract for producing training systems to the EIDS standard. Matrox offers three basic versions and many options for its LVC-2001 system. The basic versions are for playback, authoring without pre-mastering, and authoring with pre-mastering.

The Matrox system is essentially a single-student station, although networking expansion is possible. The system is designed around an IBM PC AT architecture and MS-DOS operating system. It runs most authoring languages for the PC AT. It is in the middle range of capability for microprocessor training systems, although it has some very powerful features for storing both digital and analog data on the optical disk. It may have some limitations with respect to processing high-resolution digital images due to memory constraints.

Wicat. Wicat has been producing training system hardware and software for many years, and offers a wide variety of systems and options. For the purposes of this survey, we have elected to review the top-of-the-line Wicat System 3220. The Wicat System 3220 is a multi-user system designed for up to 64 simultaneous students. It uses a proprietary operating system and authoring language. Its capability is at the high end of the spectrum, although it may have some limitations with respect to storage of high-resolution digital images. A second optical disk dedicated to digital image storage may be required.

Matrox Electronics Systems Limited

1055 St. Regis Boulevard
Dorval, Quebec, Canada H9P2T4
514-685-2630
Attention: Mr. Gerry Sullivan

WICAT Systems

P.O. Box 539
1875 South State
Orem, Utah 84058
801-224-6400
Attention: Mr. Milton Sanders

Digital Equipment Corporation

Educational Technologies Group
30 North Avenue
Burlington, MA 01803
617-273-7665
Attention: Mr. Peter Bowers

Applied Interactive Technologies, Incorporated

621 Lakeland East Drive
Jackson, Mississippi 39208
601-939-2987
Attention: Ms. Ruby Hendricks

Figure A-1. Training System Points of Contact

DEC. DEC's interactive videodisk training system can be used in any of several configurations. Any member of the VAX computer family can run the courseware authoring software (including the MicroVAX). There are two playback systems: the PRO IVIS/Videodisk and the PRO IVIS/Videodisk Touch System. One provides a touch screen and the other does not. Courseware can be run on a stand-alone PRO IVIS station, or PRO IVIS stations can be networked to a VAX or MicroVAX. The system is limited to a pixel density of 980H by 240V, making it unsuitable for display of high-resolution digitized images. The resolution is limited by the graphics overlay board in the PRO IVIS, and by the courseware authoring software.

AIT. The AIT System 6440 is a single-user system designed around the PC XT architecture. Its capability is at the low end of the spectrum. It has significant limitations with respect to both storage and processing of high-resolution digital images.

Computer Subsystem

Matrox. The Matrox computer subsystem is essentially an IBM PC AT. The processor is a 16-bit Intel 80286 chip (which can be upgraded to a 32-bit 80386 chip) and an optional 80287 math co-processor. Two alternative bus architectures are available: the Multibus standard (LVC-2001) and the IBM PC standard (LVC-2001/AT). Both are "100% software and hardware compatible with the IBM PC AT and will run any IBM PC AT software." It has 512KB of RAM and 64KB of ROM BIOS, expandable to 128KB of ROM BIOS. It has a standard clock, keyboard interface, and serial and parallel ports. The basic system has three free expansion slots, although Matrox provides an expansion bus backplane to add expansion slots. The MS-DOS operating system is used.

Wicat. The Wicat System 3220 computer subsystem is based on the 32-bit Motorolla 68020 chip with a 68881 co-processor using the Multibus standard. The basic system comes with 4MB of RAM, expandable to 12MB. Memory management is performed by a dedicated processor (68851 chip). It can have up to eight parallel ports, up to 64 programmable asynchronous serial ports (RS232C), and up to eight programmable synchronous ports. It has an expandable bus. The Wicat WMCS operating system is used.

DEC. The DEC approach can use any of the VAX family of computers for authoring a course. Playback requires the PRO IVIS based on the Professional 350 computer workstation. The Professional 350 is housed on one board. It has a keyboard interface. There are expansion slots, two of which are occupied by video modules and one of which is required for a fixed disk interface. We have not been able to determine how many free slots there are for other devices. PRO IVIS workstations can be networked to a VAX so that courseware can be run on the VAX with the PRO IVIS stations controlling the videodisks.

AIT. The AIT System 6440 computer subsystem is based on the PC XT architecture with the 16-bit Intel 8088 chip. One of the eight expansion slots houses the high-performance option board allowing the processor to operate at 8.0 MHz instead of 4.77 MHz. It has a single parallel port and a single RS232C serial port. The MS-DOS operating system is used.

Courseware Authoring Subsystem

Matrox. The Matrox LVC-2001 (/AT) system is capable of running most authoring languages for the PC, although some authoring subsystems may not be able to take full advantage of the hardware capabilities. The PILOT PLUS language is available with appropriate I/O drivers for the LVC-2001. If the hardware configuration is modified, the authoring subsystem software may also have to be modified to be compatible with the upgraded hardware.

Wicat. The Wicat System 3220 uses the Wicat WISE authoring and delivery software, and the Wicat SMART training management software. WISE is a very powerful authoring and delivery system. It comes with courseware documentation and creation tools. WISE uses a frame-based language which supports menus, graphics and text presentation, video control, digitized video, free student response, networking, external program execution, algebraic calculation, test management, and multiple terminal simulations. The SMART management software administers courses, monitors system resource usage, administers students, and produces reports on student progress. Wicat is working on making their software EIDS compatible for use on the Matrox hardware.

DEC. The DEC courseware authoring subsystem is called the VAX PRODUCER. It contains two software programs for authoring: VAX DESIGN for courseware logic and VAX DRAW for courseware graphics. An interpreter is used for delivery and playback. The software supports linking to independent programs, interactive videodisk control, and chaining of separate VAX PRODUCER programs. It provides variable type declaration, block structure with hierarchical units and branching control, handling of special function keys, a backup facility, and special constructs to handle windows and menus. The software for graphics overlays is designed to run with the PRO IVIS overlay card and is limited to a pixel density of 980H x 240V.

AIT. The AIT System 6440 uses the AIT IMSATT authoring and delivery software. The other authoring software designed for the PC may be able to be run on the System 6440, but may not be able to take full advantage of the system's features. The IMSATT software provides full software control of the system resources including videodisk control and text and graphics overlay. The IMSATT software bundles the premastering subsystem with the authoring subsystem. IMSATT integrates an expert system shell for the construction of rule-based expert systems

as a courseware element. IMSATT is an extensible language written in the FORTH programming language.

External Communication Subsystem

Matrox. The Matrox LVC-2001 does not provide external communications other than the parallel and serial ports. There are expansion slots available for communication cards. Appropriate communication software would have to be provided separately.

Wicat. The Wicat System 3220 does not provide external communications other than the parallel and serial ports. There are expansion slots available for communication cards compatible with the Multibus standard. Appropriate communication software would have to be provided separately.

DEC. The PRO IVIS has one asynchronous RS232C serial port. We have not been able to determine whether or not there are expansion slots for an ASAS/ENSCE specific communication card. VAX hosts have expansion capabilities for special communication hardware.

AIT. The AIT System 6440 does not provide external communications other than the parallel and serial ports. There is an expansion slot available for a communication card compatible with the IBM PC bus standard. Appropriate communication software would have to be provided separately.

Magnetic Media Mass Storage

Matrox. The Matrox LVC-2001 comes with two floppy drives with controllers on the computer subsystem board. The playback-only version does not have a fixed disk. The authoring and pre-mastering systems come with a 20MB fixed disk interfaced to the computer subsystem through a SCSI board occupying a single expansion slot.

Wicat. The Wicat System 3220 can run floppy disk drives from its SCSI interface boards. The basic system has a 512MB fixed disk. Additional 128MB fixed disks can be interfaced with SCSI boards on the main bus.

DEC. The DEC PRO IVIS is not designed for use with floppy drives, although it may be possible to add them if necessary. It is designed for use with a 10MB fixed disk for mass storage of digital data.

AIT. The AIT System 6440 can handle up to four floppy drives from the computer subsystem without adding a controller board. The basic

system has one 20MB fixed disk interfaced to the computer subsystem through a SCSI board occupying a single expansion slot.

Networking Subsystem

Matrox. The Matrox LVC-2001 can be modified by adding a network interface board. This consumes an expansion slot on the computer subsystem. We do not know if any existing authoring and delivery software supports networking.

Wicat. The Wicat System 3220 comes with a network ETHERNET PCB interface. The WISE authoring language is designed to support networking.

DEC. The VAX PRODUCER courseware authoring subsystem is designed to support single-student PRO IVIS playback stations networked to a VAX or MicroVAX.

AIT. The AIT System 6440 can be modified by adding a network interface board, although this consumes one of the limited number of expansion slots in the computer subsystem. The IMSATT authoring subsystem can be extended to exploit networking capabilities.

Optical Disk Subsystem

Matrox. The Matrox LVC-2001 uses third-party laser disk players. The player is controlled by the digital data recovery (DTR) board. Analog audio/video signals go directly to the video graphics overlay (VGO) board, but digital frames and digital audio for sound-over-still go to the digital data recovery board. The BIOS for player control and data recovery reside on the video graphics overlay board. This board can retrieve up to 16 frames of digital data (276KB) or 16 frames of digitized audio (65 seconds playback). The optical disk can store up to 1800MB of digital data, 120 hours of audio sound-over-still, 54,000 still video frames, or 30 minutes of action analog video.

Wicat. The Wicat System 3220 uses third-party laser disk players. Normally only audio/video data are stored on the laser disks; digital data are stored on magnetic fixed disks. The laser disk players are interfaced to the graphics boards in the monitor chassis. An additional laser disk player connected to the computer subsystem bus could be added for high-resolution digital images. Wicat technology does not support mixed video and digital data on the optical disk.

DEC. The DEC PRO IVIS uses the optical disk solely for audio/video data. There is no facility to store digitized audio for sound-over-still or digital data on the optical disk. Third-party disk

players such as the Sony LDP-1000 and the Pioneer Model III PR7820-3 are plug-in compatible.

AIT. The AIT System 6440 uses the optical disk solely for audio/video data. It comes with a Sony LDP-2000 12-inch laser disk player, although other third-party players could be used.

Video I/O Subsystem

Matrox. The Matrox LVC-2001 uses a Matrox-proprietary video text/graphics overlay (VGO) board. The board has an IBM EGA/CGA compatible mode. It has a 640H x 400V display mode with 16 colors, matching the EIDS standard, and an "enhanced" display mode of up to 720H x 480V pixels. The board fits into one expansion slot. Video signals from the videodisk player go to the graphics board through an RS232C interface. Any of several monitors can be used including NTSC, RGB, and television monitors. The board has a game port for touchscreen, lightpen, or mouse input, although the touchscreen is not a part of the basic system. The VGO board has ROM BIOS for both itself and for the audio/digital data decoding (DTR) board used in the optical disk subsystem.

Wicat. The Wicat System 3220 uses a Motorola 68000 graphics processor housed with the monitor and connected to the computer subsystem through one of the 64 intelligent RS232C interfaces. Each display unit has videodisk interface capabilities. The graphics board has 640H x 480V pixel resolution with 16 color contrast and two independent graphics memory planes. BIOS are on the graphics board. The subsystem has a 14-inch RGB analog monitor.

DEC. The DEC PRO IVIS video I/O subsystem uses two video boards: an extended bit-map module and a bit-map single-plane video module. These boards control the videodisk player, overlay text and graphics on video output, and output signals to the 13-inch analog RGB monitor. The display pixel density is 960H x 240V. A touchscreen is supported, as are joysticks and graphics tablets.

AIT. The AIT System 6440 uses a third-party video graphics board and a separate video overlay board. The graphics board is compatible with the IBM EGA/CGA standard. Its pixel density is 640H x 400V with four color contrast, or 320H x 200V with 16 color contrast. The system uses a 14-inch analog RGB monitor operating in 2:1 interlaced mode at either standard NTSC or PAL vertical and horizontal rates. The signal from the videodisk player goes to the overlay board. The basic system has touchscreen input. Device driver BIOS are on the boards. It is a single monitor system.

APPENDIX B

INVENTORY OF EXISTING AUTHORING SYSTEMS

APPENDIX B

INVENTORY OF EXISTING AUTHORING SYSTEMS

General

This appendix inventories twenty-six individual authoring system/languages. Each is described in terms of:

- Hardware and Software Requirements
- Graphics
- Branching
- Editing
- Response Analysis
- Computer-Based Management/Utilities
- Software Interface
- Prompting
- Cost

Figure B-1 presents an overall summary of authoring system capabilities for all systems included in the survey. The suitability for ASAS of any of these systems will depend heavily upon the specific hardware/software/courseware characteristics selected for the ASAS CBT system. Often specific NDI training systems come with the authoring system as an integral component. Customized systems can often be configured to be compatible with a selected authoring language or system.

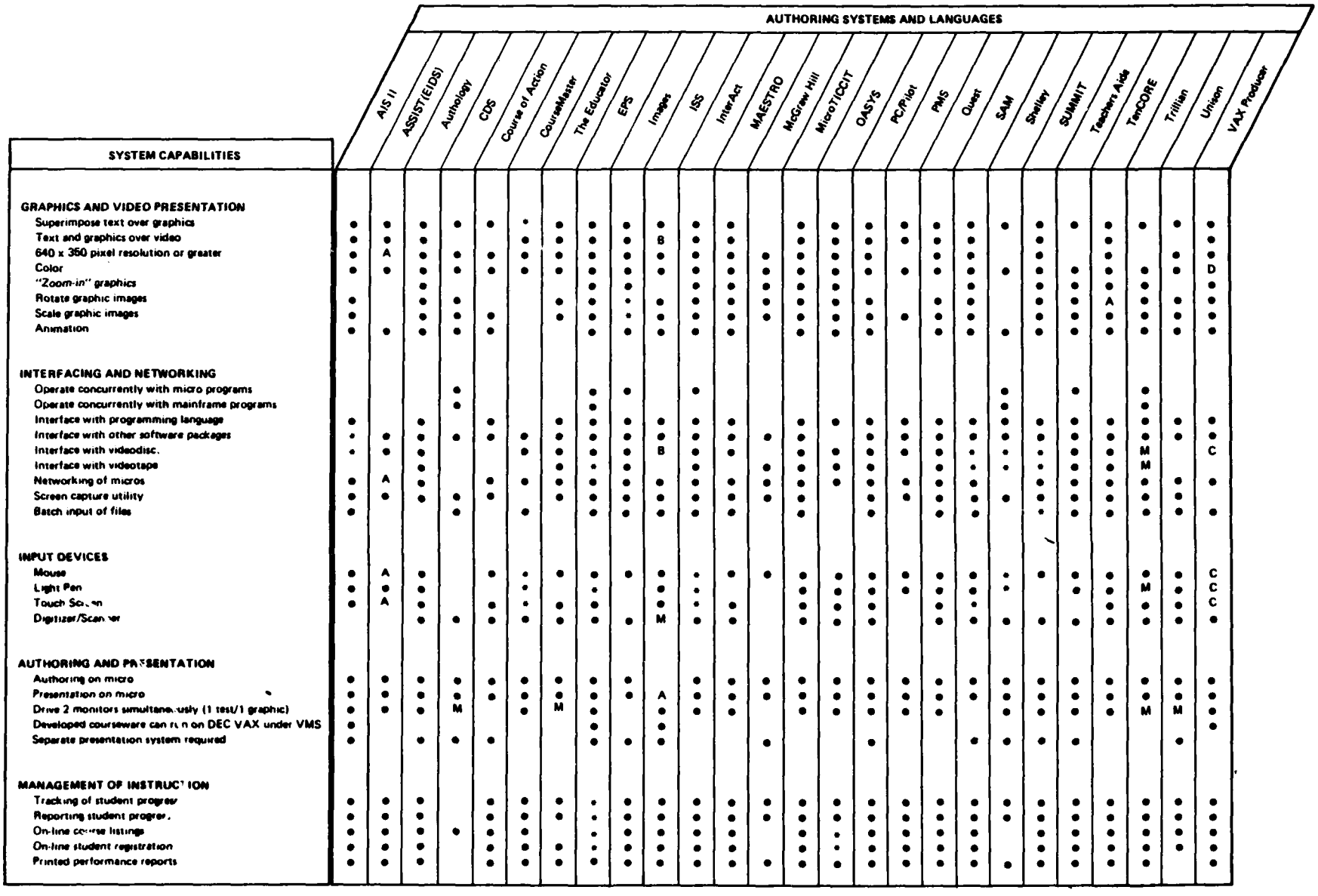


Figure B-1. Summary Comparison of Authoring System Capabilities

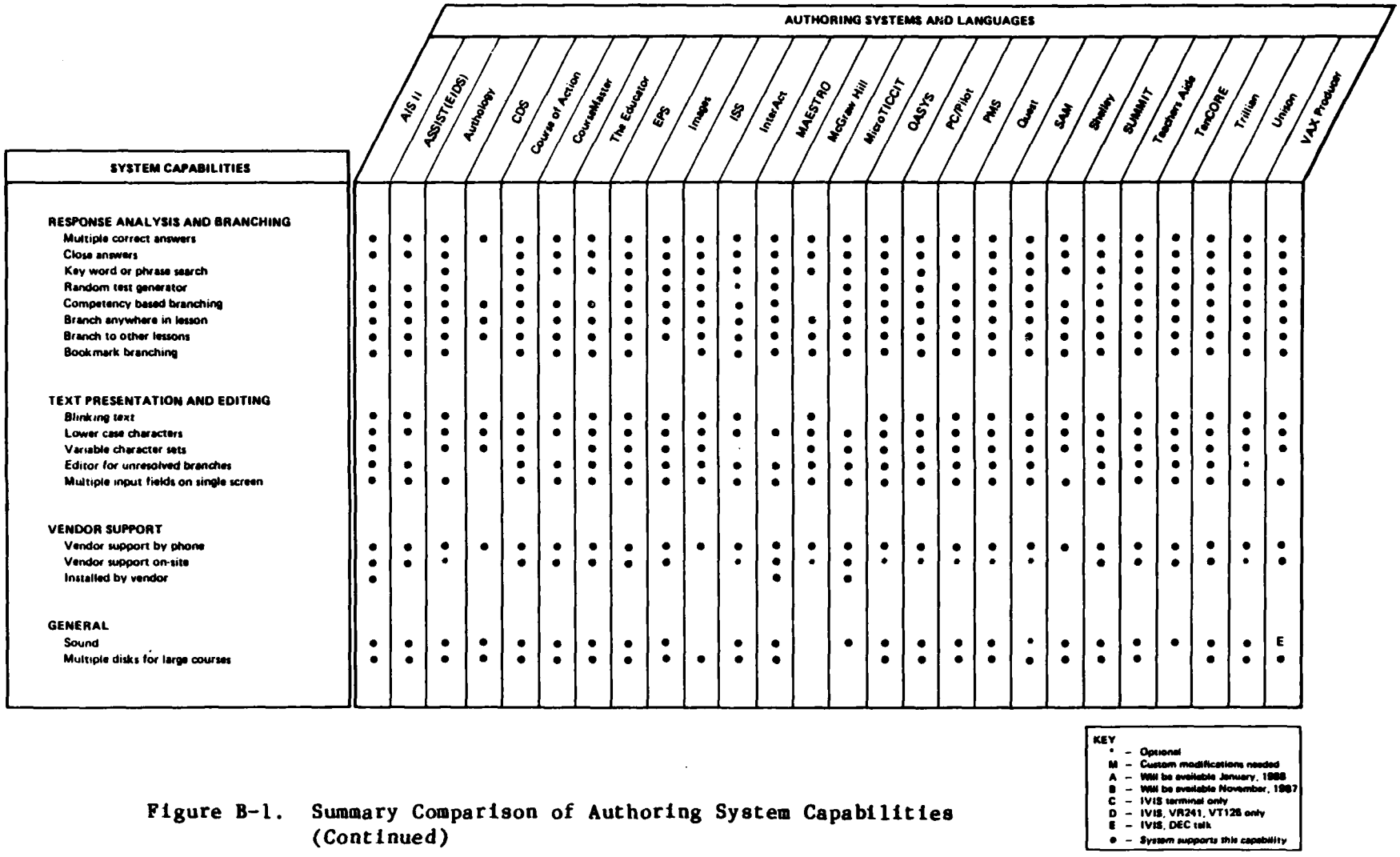


Figure B-1. Summary Comparison of Authoring System Capabilities (Continued)

AUTHORING SYSTEM

AIS-II/AIS-PC
McDonnell Douglas Astronautics Company
1390 South Potomoc
Suite 124
Aurora, CO 88012
(303)337-6303
Contact: Dave Showers

Introduction

The AIS series of aurthoring systems (AIS II and AIS PC) are comprised of three separate modules. These modules - the authoring, management, and presentation systems - can be used as a package or individually. The AIS II system is designed for presentation and authoring in a mainframe environment. The developed courseware can, however, be presented on the IBM PC in a stand-alone mode. The AIS PC system supports authoring and presentation at the microcomputer level with courseware adaptable to mainframe presentation.

Hardware and Software Requirements

AIS PC

- IBM PC, Zenith 248, or compatible
- IBM memory and 20MB disk storage
- MicroVAX and AT&T 3B2 also supported
- PC DOS, UNIX, or VMS operating system

AIS II

- Gould, VAX, or AT&T 3BX series
- Runs on 16 different terminal types
- VMS or UNIX operating system
- Able to present courseware on standalone IBM PC and compatibles with 256K and running MS DOS

Graphics

- 640x350 resolution (EGA board)
- Full color vector graphics
- Lines, rectangles, circles, ellipses, etc.

Branching

- Unlimited number of paths
- Able to branch to any frame in any other lesson
- Author may limit student branching opportunities at certain points in lesson
- Branch on student's test score (competency based), on the number of attempts at a question, and to bookmarks set in the lesson

Editing

- Line, full-text and graphics editor
- Line-by-line editing for text

Response Analysis

- Up to 9 anticipated responses of up to 60 characters
- 3 wild card characters for any single character or any number of characters
- Question forms include multiple choice, true/false, matching, and short answer

Computer-Based Management

. Records student's score (raw and percentage), number of attempts for each question, and time taken on each section

. Next step in course/lesson is prescribed for student

. Student can be automatically branched to next course/lesson

Software Interface

. Interface with programs written in any other programming language with two-way variable passing possible

Prompting

. Pre-formatted menus and user developed templates

. Menus may be bypassed

. All system editors are menu driven

Cost

AIS PC

. $3900 Single Station microcomputer (authoring sytem, management system and presentation system

. $10,500 up to 15 networked stations (authoring system, management system and presentation system)

. $600 each for student stations (presentation and management systems only)

. $3500 up to 15 networked student work stations (presentation and management systems only)

Cost

AIS II

- $22,900 for authoring system, management system and presentation system for MicroVAX
- $90,000 for authoring system, management system and presentation system for VAX 8600

Assist

AUTHORING SYSTEM

EIDS Assist Authoring System
Computer Sciences Corporation
813 Diligence Drive, Suite 110
Newport News, VA 23606
(804)873-1024
Contact: John Sheriff

Introduction

EIDS Assist is the software system for the Army's EIDS standard. Assist uses the IV-D authoring system as a nucleus and has created a special interface to make it compatible with EIDS. Additional features are presently being added so Assist can better meet the intended uses of EIDS. With Assist, a training developer can manage the entire production of an IVD project. The system automates the projects development process by:

- Structured storyboard development
- Generating scripts and reports
- Managing production and editing
- Providing on-line help screens
- Identifying errors
- Facilitating quick program updates

Assist will be fully operational with the EIDS system by January of 1988. All courseware developed with PMS (EIDS Interim Software) will be converted to Assist. EIDS Assist is faster, more user friendly, and generally more powerful across the board than PMS.

Hardware and Software Requirements

- IBM AT and XT with PC or MS DOS
- Sony SMC 70 with government/military operating system
- Matrox EIDS system by 1/88

. Hitachi or Sony videodisc players

. Graphics overlay board

. Supports light pen, keyboard, and keypad

. Mouse, trackball, joystick, and touchscreen by 1/88

Graphics

. TecMar Graphics Master Board - 320x200 resolution with 16 colors

. By 12/87 system will also support New Media Graphics, Matrox EIDS Board, and Sony View System with 640x400 resolution and 16 colors

Branching

- Program can branch on basis of:
  - . author-designated "go-to"
  - . past performance
  - . student/user characteristic (e.g., rank, skill level)
  - . number of times student has repeated a loop
  - . random choice
- User can at any time:
  - . back-up to last frame/sequence(s)
  - . back-up to last choice frame(s)
  - . back-up to last menu(s)
  - . suspend, bookmark, or exit program
  - . go-to a placemark

Editing

- Supports quick editing of text, flow, and active touch areas in program
- Manages editing of premaster videotape

Response Analysis

- Fill in the blank responses allow for exact matches, wildcards (near matches) and margin for error (mathematical responses)
- Multiple choice and true/false responses

Computer-Based Management/Utilities

- Provides on-screen report (number correct, number missed, and time) to student
- Provides instructor with itemized or summarized student reports on screen or hard copy
- System manages the entire development production, and authoring process
- Students can make notes on screens for their aid or author revision

Software Interface

- "Hook" function is available to gain data and some screens from application and other programs

Prompting

- System is database driven - author completes electronic story-boards which build an interactive database

Cost

- The government owns unlimited distribution rights to Assist

AUTHORING SYSTEM

Authology
Ceit Systems, Inc.
25 E. Trimble Road
San Jose, CA 95131
(408)943-9797
contact: Stephen R. MacDonald

Introduction

Authology is an authoring system that employs three software programs: Author, Presenter, and Student record manager. Author is a window-based program for designers with limited programming skills. Presenter is a software program which manages courseware presentation to the student. Student records manager is a software program which maintains and graphs student and group data for evaluation of student progress and courseware effectiveness.

Hardware and Software Requirements

Text and Graphics Authoring

. IBM PC, XT, AT or compatible with 384K RAM and MS-DOS 3.i

. One floppy disc drive

. EGA graphics card and color monitor

Text, Graphics, and Video Authoring (same as above except:)

. 640K RAM and 20mb hard drive

. Sony KV1311 or PVM series RGB/composite color monitor and a video source

. Supports selected RS-232 laser disc player, McDonnel Douglas laserfilm player, and Sony, Panasonic and JVC industrial VCRs

. Any Digitizer that creates files in a T/r Halo graphics format is supported

Graphics

- System includes Dr. Halo II graphics generation package
- Graphic library to store and retrieve created graphics
- Uses icon driven system to develop graphics
- Draw, cut and paste, move and rubber stamp images
- Choice of color, patterns, symbols, line widths, type faces, airbrush densities and image scaling features
- Dropshadowing to give labels and titles depth and impact
- Animation featuring variable timing, straight or curved paths, multiple image sequencing
- Maximum Resolution 640x350 (EGA card). Other cards can be custom fit

Branching

- Unlimited destinations per decision
- Based on responses, question or objective results, random, student records, and return codes from external programs
- Branching to other lessons, routines, or external programs

Editing

- Full screen text editor provides 256 foreground and background combinations
- Full word processing features
- Timed text disclosure
- Music and sound effects can be edited into text
- Text saved in the text file can be retrieved, duplicated or modified for reuse in same or other lesson
- Full video editor with compressed audio loading and playing supported

- Bookmark branching
- Bit mapped graphics editor
- Adjust window size and placement

Response Analysis

- Unlimited feedback for true/false, multiple choice, matching and short answer (up to 80 characers with wild cards)
- Escape from lesson at any point

Computer-Based Management

- Analysis of student and group performance and lesson effectiveness
- Graphical and printed reports of analysis
- dBase III compatible classroom database management

Software Interface

- Able to capture screens from other programs
- Interface is possible with languages written in almost any language

Prompting

- Author-selected response types
- Menus and more specific prompting is author developed

Cost

- $4995 Authoring and Presenting Package (includes operating key for 1 system and a perpetual license for software)
- $995 for unlimited use presenter package for one system
- $600 annual maintenance fee (follows 90-day free period)
- Volume discounts are available

Notes

. Plans are in operation to part authology to the Unix environment (by 1/88) and to the VMS environment (no date set)

CDS

AUTHORING SYSTEM

Concurrent Development Series (CDS)
Vasco Corporation
1919 South Highland Avenue
Suite 118-C
Lombard, IL 60148
(312)495-0755
Contact: Richard L. Tempelman

Introduction

CDS is a series of products which allows training to run at the same time (concurrently) as an application program. The concurrent authoring system (CAS) allows an author to produce training directly over MS/PC-DOS software, without the need to simulate these applications. Simulating subject software is very time-consuming and uses up valuable storage space. The Concurrent Micro-Mainframe System (CMS), allows a workstation to run the actual mainframe application while windows of instruction are authored over the program. The Concurrent Glossary System (CGS) allows the author to produce on-line reference glossaries. The information appears in windows over the application program so users never have to exit the application to access on-line reference. CGS may run as a stand-alone product or as a companion to the Concurrent Authoring System (CAS).

Hardware and Software Requirements

- Authoring and presentation systems run on IBM PC, XT, AT or compatible which, in the micro-mainframe series, is connected to mini or mainframe by as serial port
- 512K RAM and hard disk
- Color graphics board and color monitor
- Micro-mainframe series works with any mainframe or minicomputer under any operaing system
- MS or PC DSO 2.0 or later
- CGA and EGA Boards Supported
- Maximum 640x350 resolution (EGA card)

Graphics

- Graphics built from upper ASCII character set using electronic photograph and stamp feature
- All CDS products run in text mode, and can run over an application in graphics mode
- Uses widow-based instruction overlaying application program

Branching

- Maximum 18 branching paths at each level
- Release events by time delay
- Trainee can switch training applications without rebooting

Editing

- Text and graphics editing by overstriking
- Editing by use of electronic photograph and stamp feature

Response Analysis

- Matching and fill in response only
- Exact match required
- Maximum 132 characters per response

Computer-Based Management

- N/A

Software Interface

- Concurrent Authoring System (CAS) will run concurrently (simultaneously) with any MS/PC-DOS application software
- Concurrent Micro-mainframe System (CMS) will run with any mainframe or minicomputer under any operating system

Prompting

. For control data - one preformatted menu with nine items

. For on-screen display - default window that can be moved, sized, or colored

Costs

. Concurrent Authoring System (CAS)

- $5000 perpetual use
- $500 annual fee in lieu of royalty
- $500 maintenance fee (updates and telephone support)

. Concurrent Glossary System (CGS)

- $2000 perpetual use
- $200 annual maintenance fee
- $200 annual fee in lieu of royalty
- $1500 for perpetual use if CGS is bought in conjunction with concurrent authority system. Maintenance and royalty remain at $200/each.

. Concurrent Micro/Mainframe System (CMS)

- $20,000 per mainframe system, perpetual use
- $4000 annual maintenance and royalty fee
- $10,000 annual rental, includes maintenance and royalty

NOTE: With the use of a terminal emulator, the Concurrent Micro/Mainframe system (CMS) can display instructional information directly over the operational software. Microcomputers run the authoring and presentation systems under DOS, while mainframes, running under any operating system, "think" they are communicating with a dumb terminal. Therefore, the microcomputer is operating in two modes - in the terminal mode, and in a stand-alone mode running the training. The training information is stored in the microcomputer and the operational software resides on the mainframe.

AUTHORING SYSTEM

Course of Action
Authorware, Inc.
8621 Pine Hill Road
Bloomington, Minnesota 55438
(612)941-5752
contact: Michael W. Allen

Introduction

Course of Action is a courseware design and authoring system which was developed to take full advantage of the MacIntosh human interface and graphics capabilities. By arranging icons representing courseware functions into operational sequences, authors can easily develop interactive lessons. The structure of the operational sequence is automatically represented in a flowchart-like fomat. By selecting one of the icons on the course flow line, the author can edit or reassemble that course component. The system allows rough designs and experimental sections to be viewed as they are developed. To begin developing courseware the author must learn the function of only 8 icons. An enhanced version of this system, Best Course of Action (BCOA) is available.

Hardware and Software Requirements

- MacIntosh 512K RAM or MacIntosh Plus for authoring and presentation
- Any digitizer that can create a file in a MacPaint format, be written to the Mac clip board/scrap book, or can appear on the screen is supported. Examples include Thunderscan and Art Grabber.

Graphics

- Any graphics may be imported from any Macintosh application and resized
- Text and graphics can be placed within displays in any mix and at any location
- Author can mix line-drawn graphics with bit-map graphics and scanned art
- 35 fill patterns plus transparent fill

- Animation, fade, and dissolve capabilities
- BCOA features extensive animation and "movie" capabilities that show animated sequences at author specified rates up to 30-frames per second

Branching

- Unlimited number of paths
- Path selection options include sequential, random, random without replacement, and calculated
- BCOA also calls interactive sequences stored in the knowledge base
- Time-delayed branching

Editing

- Full-screen text and graphics editor
- WYSIWYG style editors
- MacPaint graphics editor and MacWrite text editor may be used with systems own editors
- Author may edit courseware during presentation

Response Analysis

- Unlimited number of responses, wildcards, and optional judging
- Short answers can be analyzed as character strings or word lists
- BCOA retrieve student-requested information from a knowledge base, which stores text and graphic elements of the courseware
- Author-defined variables can be used in all calculations
- Student-moveable objects and screen "hot spots"
- Multiple student input modes

Computer-Based Management/Utilities

- Automtic collection of student and course performance data
- Unlimited user variables for extended data collection and customization
- Author-designed performance reports
- Able to call subroutines and interface to other programs for data collection and statistical analysis

Software Interface

- Can interface with the programming language ("C")
- Almost any Macintosh application will produce compatible display material

Prompting

- Entire system is icon-driven with pull down menus and author developed templates
- Icons are selected and moved with a mouse input device

Cost

- $695 Course of Action system, perpetual use
- $2500 The Best Course of Action, perpetual use
- $105/year updates and hotline for Course of Action
- $375/year updates and hotline for Best Course of Action (BCOA)
- $33 courseware delivery system (10 disks)
- $25 Demonstration disk
- Volume and academic discounts are available

Notes

- A variety of "add-on" options are available to configure the system to an organizations needs and budget. These include advanced animation, digitized sound videodisc, content library/ outline, AI-based system and others. Best Course of Action provides all capabilities the system can offer.

- Presentation on IBM PC compatibles and Apple IIGS by 11/87.

AUTHORING SYSTEM

CourseMaster
Inter Digital, Inc.
258G Water Street
Lebanon, New Jersey 08833
(201)832-2463
Contact: Dr. Frank L. Greenagel

Introduction

CourseMaster is a set of authoring utilities for creating both computer-based training (CBT) and interactive videodisc (IVD) programs. The system "piggybacks" on any word processor that produces standard text files. This allows CourseMaster programs to employ the editing flexibility and power of a word processor. The system is also able to use any graphics program. CourseMaster programs are written in compiled Basic, with a number of machine language subroutines. The system is essentially a compiler of text and graphic information.

Hardware and Software Requirements

- IBM PC, XT, AT or compatibles with minimum 256K RAM
- Two 360K floppy disk drives
- MS DOS
- A separate version is available for the Wang PC
- In order to drive 2 monitors, graphic images must be contained on Videodisc.

Graphics

- Output of any graphics program can be used
- Graphic screens must be individually loaded so a dely of 1-3 seconds is experienced between graphic frames
- Most graphics capabilities are contingent upon graphics program used

Branching

- Unlimited number of paths by branching singly or in combination with any of 256 stored answers or calculations
- Competency-based branching within or between files

Editing

- Any word processor, that produces standard text files, may be used to edit text (Word Perfect 4.1 recommended)
- Access to full editing as well as dictionary and thesaurus capabilities of word processor

Response Analysis

- Up to 80 characters per response
- Up to 40 different word-lists of unlimited length per question can be matched
- Very powerful key phrase search features

Computer-Based Management

- Monitor progress of 100 students per disc
- Store any or all answers given by student
- Printed student progress reports in author created or system provided formats

Software Interface

- Can input and manipulate code from other programs

Prompting

. 20 different page types (templates) for specific instructional delivery methods and functions -- true/false, fill-in the blank, matching, rank order, cursor or graphic movement, printout, etc.

Costs

. $25,000 for perpetual use. Customer may make unlimited copies for internal use

. 16 hours of free on-site training

. Reference manual, tutorial, and demonstration lessons included in price

EDUCATOR

AUTHORING SYSTEM

The Educator 5.0
Spectrum Training Corporation
Fifty Salem Street
Lynnfield, Massachusetts 01940
(617)245-8500
Contact: Jean M. Collins

Introduction:

The Educator is a menu and prompt driven authoring system written in the C Programming language and introduced in 1981. The system combines fully integrated text and color graphic capabilities with versatile branching logic, windowing and application simulation. The educators capture utility allows application software screens to be incorporated into the lesson with a single keystroke.

Hardware and Software Requirements

- IBM PC, XT, AT or compatible with a minimum of 320K RAM
- Visage or InfoWindow hardware and software required for video-disc interface and, input via mouse or touch screen
- Will support any digitizer that creates files in any microbased graphics program format (e.g., PC Paint, Dr. Halo)

Graphics

- Bit-mapped and character graphics can be created in both 80- and 40-column formats
- Draw boxes, circles, ellipses, complex curves, and connected lines of any angle
- Copy, move, scale, point, and save into graphic libraries
- Design, scale and store "custom" fonts
- Windows can be any size, any frame type, use any branching option, and incorporate any text and graphics features
- Unlimited windows can be overlayed on regular frames or other windows

- Fill-in-the-blank-windows provide an overstrike capability for application simulation
- Input through mouse, keyboard or touch screen

Branching

- Unlimited branching on specified keystroke or fill-in response with options for pausing, erasing, and rolling display
- Branching based on learner response, abilities, and needs
- Ability to branch to external software allows author to create application simulation
- Branching fields can include multiple frames and display options

Editing

- Full screen editor with integrated text, graphics, color, branching, performance tracker, and video editing
- Capture utility allows the author to incorporate and manipulate captured application screens
- Global search and replace for text and color
- Ability to copy, delete, and renumber ranges of frames and edit screns as you replay the course
- Copy, move, insert, and delete functions for text and graphics
- Automatic text centering, quick-margin set and word wrap

Response Analysis

- Up to 10 learner response patterns of 75 characters each
- Multiple response patterns allow for specific feedback and individualized paths through training
- Six wild cards, special operators and a range feature allow branching to specialized feedback for correct responses along with anticipated and unanticipated incorrect responses

EDUCATOR

Computer Based Management/Utilities

- Student performance can be scored and statistically summarized
- Correct answers and number of times allowed for a correct response can be designated
- Up to ten categoreis of questions can be defined allowing performance and various skill sets to be measured and reported
- Summary information is provided for the learner; summary charts and histograms available to administrators include raw scores, percentages, mean, and standard deviation
- Display a directory of frames with first line of text, response options, and branching information
- Print frames including text, graphics, branching, window parameters, and student performance information
- Compress final program to greatly increase frames per disk

Software Interface

- Linking from training packages to executable software programs/ applications and back by means transparent to learners
- Capture utility allows the author to incorporate and manipulate captured application program screens

Prompting

- Menu and prompt driven
- Authors can also create their own structure using automatically generated prompts or prompts of their own creation
- Development shortcuts and the ability to set package defaults are built in to assist the experienced author
- On-line help for key functions

Cost

- $3500 yearly license
- $5000 two-year license
- $7000 perpetual license - $500 annual fee (beginning Year 2) for support and enhancements
- Quantity discounts are available

Optional Software

- $595 for Capture Utility software
- $500 for Color Filter Software which allows programs developed on color/graphics system to be properly presented on monochrome systems
- $1500/year for Video Capability/Positional Input Screen which allows for videodisc interface and touch screen and mouse input
- $1500 for Object Code and User Link which allows for interface with certain programming language routines and linking from training packages to executable software programs/applications and back in a manner transparent to learners

EPS

AUTHORING SYSTEM

The Electronic Publishing System (EPS)
Cdex-Intellisance Corporation
1885 Lundy Avenue
San Jose, California 95131
(800) 982-1213/(408) 432-0430
contact: Bill D. Royer

Introduction

The Electronic Publishing System (EPS) is a software productivity system that automates the development of concurrent interactive training systems (CBT and Interactive Videodisc [IVD] systems). The system allows the author to develop courseware on one computer system and present it on a variety of additional systems without having to re-edit individual versions. This capability provides for the automatic remapping of differences in character sets, colors, keyboards, and terminal interfaces. EPS also allows the author to:

. Use multiple displays to display a single program.

. Download courseware from mainframes to PCs.

. Execute lessons on mainframes with PC's as terminals.

In addition, the system contains 300 pre-formatted templates which greatly reduce authoring time.

Hardware and Software Requirements

. Authoring an IBM PC, UNIX, Amdahl and DEC VAX computers.

. Presentation on any computer system that supports the "C" or Pascal languges.

. Any digitizer that creates DR. HALO or PC-Paint compatible files is supported.

Graphics

. Drawing routines to quickly create frames, boxes, circles, elipses, etc.

. Text and graphic animation routines

- Text graphics and pixel graphics displayed on the same screen
- Import screens from application programs or other external sources
- Pop-up windows
- System provided or author created screen and graphic templates for quick implementation of standard designs
- System provided or author created character sets incorporating multiple sizes, colors, and proportional spacing
- Simulations and modeling functions
- Graphics and template library
- Screen resolution contingent on board used (can be as sharp as board supports)

Branching

- Unlimited number of branching points
- Unlimited number of branches per point
- Branch on any criteria or set of criteria
- Use variables or calculations to determine branch timing and destination

Editing

- Fully functional graphics, screen, and multi-window text editor built in

Response Analysis

- No limitations on the types of questions and responses that can be created
- Use multiple input devices simultaneously
- Terminate input after elapsed time

- Search the student's responses for a particular response
- Search a complete response to make sure a partial response is not contained within it
- Parse out responses in order to judge sections of the response
- Determine length of response
- Use numerical and alphabetic variables in order to perform conditional response judging
- Exactly match trainee's and anticipated responses
- Find a partial response(s) before another in a complete response
- Find a partial response(s) after another in a complete response
- Accept and judge all keys

Computer-Based Management/Utilities

- Store any data required for performance or use analysis
- Store data in the format required for external analysis or reporting systems (e.g., dBase III, Lotus 1-2-3, etc.)
- Select appropriate training topics based on test performance, empirical criteria, job requirements, etc.
- Time and date-stamp stored data
- Attach electronic notes to any screen to specify corrections, modifications, etc.
- Execute a structural analizer program that will print out

    1) the entire program structure,
    2) all questions and response groups,
    3) input filtering and active keys,
    4) illegal branches, and
    5) author-defined deviations from style.

Software Interface

- Courseware can run concurrently with application programs
- "Pass" commands directly to any application program and thereby directly control the operation of that program from within CBT programs

Prompting

- User developed "custom" templates
- Library of over 300 instructional, screen, and graphic templates which can be author modified

Cost

Single-User Versions

- $20,000 Perpetual License, first copy or first user
- $10,000 Perpetual License, second copy or second user
- $5,000 Perpetual License, third or subsequent users and copies
- 15% of purchase price for annual maintenance and updates
- Training provided at the rate of one (1) day per $10,000 of licensing fees or part thereof
- Three (3) Runtime Environments (allows developed programs to be executed on multiple types of computer systems) provided with the first copy or user licensed
- Special Runtime Environments available on a development charge basis

Multi-User Versions

Monthly	Annual	Perpetual	
$2000	$20,000	$50,000	License, First Copy
$1000	$10,000	$25,000	License, Second Copy
$ 500	$ 5,000	%12,500	License, Third and Subsequent Copies

- 15% of purchase price for perpetual annual maintenance and update
- 12 months minimum required for monthly license
- Runtime Environments provided as per above
- Training provided as per above

NOTES: EPS offers an Expert Series System that is composed of two major components:

- Instructional Information Management System which allows programs to function as information experts by providing the author the ability to store and retrieve textual, graphical, and numerical information in a variety of formats (e.g., tutorial, reference, report, simulations, exercises, etc.)
- Embedded Training which allows programs to interface with and execute concurrently with other programs, therefore, providing "on demand" training or help to users of application programs. The user can switch between the application program and the training program without having to restart or reload either program. The system can also open windows on top of the application programs and filter a user's inputs to determine if the user is entering the correct commands, data, etc. If an error is detected, the program can automatically activate itself to provide corrective feedback.

AUTHORING SYSTEM

Images III
Computer Knowledge International
487 Sand Run Road
Akron, Ohio 44313
(216)836-1866
contact: Katherine Hirshbuhl

Introduction

Images III is a micro-based, concurrent authoring system introduced in this version in January of 1987. The system allows you to select your own text editor and employs two graphic editors (character and all points addressable). Images contains a complete management system and a graphics generator.

hardware and Software Requirements

- IBM PC, XT, AT or compatible with 256K RAM
- 2 disk drives
- MS DOS or later
- Digitizers that can display a bit mapped image on screen can be supported by Swages screen captive facility

Graphics

- Cursor placement and positioning
- Arcs, circles, lines, ellipses and boxes
- Graphic library
- 40 or 80-column character graphics
- Single-pixel handling
- Multiple graphic screens can be loaded simultaneously
- Images can support any screen resolution provided by most graphic boards

- Rotating and scaling of graphic must be performed by an interface to a separate graphics editor

Branching

- Based on question and answer analysis
- Forward/backward paging and branching
- Branch to other compiled language routines

Editing

- All ASCII text editors can be used
- Graphics, character set, and character graphics editors

Response Analysis

- Unlimited number of responses of up to 80-characters
- Formatted and unformatted questions
- Unlimited incorrect or correct answer checking
- Control over number of student responses
- Automatic wildcard searches for answers within student responses
- Automatic removal of spaces in student responses
- Unanticipated response checking

Computer-Based Management

- Menu driven sign-on levels (student/instructor/author)
- Student record editing
- Group instruction by students, courses, topics
- Student selection of topic
- Management system is menu drivn and automatically tracked

Software Interface

- Interface with any program in ASCII format
- Link to programs and data files across 16-bit
- Able to run concurrently with microbased programs

Prompting

- Menu driven through lettered or numbered options
- Each option is labeled with choices
- Self built menus available

Costs

- $3000 perpetual license for basic two station
- $5000 perpetual license for six station
- $12,000 local area network license, up to 25 stations
- Contact vendor for networks above 25 stations

Note

- Free demonstration disk is available from computer knolwedge international

ISS

AUTHORING SYSTEM

Introduction

The Instructional Support System (ISS) is an authoring system which was developed using a base obtained from the McDonnell-Douglas' AIS system. ISS is divided into two major functions: the CAI system and the CMI system. CAI provides the authoring and presentation capabilities of the system in a menu-driven and user-friendly environment. The CMI system provides comprehensive management information and administrtion implementation. It controls the scheduling of assignments, testing, remediation, and enrichment activities for each student. ISS courseware is authored and presented on DEC VAX computers. Developed courseware will be able to be presented on the Zenith 248 and other IBM PC compatibles by December 1987. Authoring on the PC will be available in April 1988. It is undetermined when the CMI function will be available at the PC level.

Hardware and Software Requirements

4-User Tempest System:

Hardware:

. MicroVAX II System, 5mb

. Memory, 4mb MOS

. Disk Controller, RD53 (2 ea)

. Extender for RQDX3

. 5.25: Rack Adaptor

. RD53 Disk Drive, 71mb (3 ea)

. TS05 Mag Tape 1600 bpi

. TS05 Cabinet Kit

. Tabletop Term (Console)

. RFI Shielded RS232 Cable (4 ea)

. Tektronix Color Graphics Terminals w/64K memory (4 ea)

. Infoscribe Printer

Software:

. MicroVMS Lic, 1-8 users

. MicroVMS Media and Doc

. TXV05 I/O Driver

. TSV05 Media and Doc

4 User Non-Tempest System:

Hardware:

. DEC MicroVAX II System, 9mb (3-RD53/TD50)

. RD53 Disk Controller

. TS05 Mag Tape 1600 bpi w/cabinet

. Cabinet Kit

. End Panels

. Tabletop Term (Console)

. RS232 Cable (4 ea)

. Tektronix Color Graphics Terminals w/64K memory (4 ea)

. Infoscribe Printer

Software:

. MicroVMS Lic, 1-8 users

. MicroVMS Media and Doc

. TSV05 I/O Driver

. TSV05 Media and Doc

8 User Tempest System:

Hardware:

. VAX 8200, 4mb (rackmount)

. Memory, 2mb, 8200/8300 (4 ea)

. Memory Battery Backup 8200/8300

. VAXBI to UNIBUS Adaptor

. UNIBUS Expander Box

. Expansion Backplane

. RA Disk Controller VAXBI (2 ea)

. RA60 205mb Disk (removable) w/o cabinet (2 ea)

. TU80 Mag Tape Subsystem, 1600 bpi, w/tempest cabinet

. Communications Controller

. Cabinet Kit

. Tempest Cabinet

. Bulkhead I/O Panel

. Filter I/O Cable Assembly (8 ea)

. Tabletop Term (Console)

. RFI Shielded RS232 Cable (8 ea)

. Tektronix Color Graphics Terminals w/64K memory (8 ea)

. Printronix Line Printer, 600 lpm

Software:

. VMS Media and Doc (8200)

8 User Non-Tempest System:

Hardware:

. VAX 8200 Computer, 4mb

. Memory, 2mb, 8200/8300 (4 ea)

. Memory Battery Backup, 8200/8300

. RA Disk Controller, VAXBI

. RA60 205mb Disk (removable) w/o cabinet

. RA60 205mb Disk (removable) w/cabinet

. TU80 Mag Tape Subsystem, 1600 bpi

. Communications Controller

. Cabinet Kit

. Tabletop Term (Console)

. RS232 Cable (8 ea)

. Tektronix Color Graphics Terminals, w/64K memory (8 ea)

. Line Printer, 600 lpm

Software

. VMS Media and Doc (8200)

24 User Non-Tempest System:

Hardware:

. VAX 11/785 Computer, 6mb

. Memory, 2 mb MS780-GA 2ECC MOS (5 ea)

. Floating Point Accelerator

. LA100 Tabletop Term (Console)

. RA60 205mb Disk (removable) w/cabinet (3 ea)

. TU77 Mag Tape Subsystem, 1600 bpi

. UDA50 Disk Controller (2 ea)

. DMF32 Communications Controller (3 ea)

. LQP02 Daisy Wheel Printer (3 ea)

. RS232 Cable (24 ea)

. Tektronix Color Graphics Terminals, w/64K memory (24 ea)

. Line Printer, 600 lpm

Software:

. VMS Media and Doc (11/785)

. Presentation on Zenith 248 and other IBM compatible by 12/87 and authoring by 4/88

Graphics

- Text and graphics are displayable in eight (8) different colors
- Graphics library to store created images
- Graphic primitives including lines, circles, arcs, ellipses, boxes, and paints
- Text and graphics can be scaled and positioned at any angle/slant
- 640x480 maximum system resolution
- Areas bounded by lines may be filled with multiple colors
- Completed or partially complete images can be scaled, rotated, or repositioned
- Windowing capabilities where text, graphics, and components of graphics can be added to and removed from display as a function of timing or student input

Branching

- Unconditionally
- Upon a specified student response
- If a specified number of frames have not been presented
- On the basis of the evaluation of an author-supplied equation
- Able to branch to other programs/files and return to the original "jump" point upon completion
- After completing an instructional module the student will be routed (branched) diretly to the on-line testing component
- Time-delayed branching is supported

Editing

- A menu and prompt driven text editor allows an author to delete segments, insert new segments, copy segments, reorder the sequence of segments, and change or delete only those segments s/he has created
- Authors can enter a segment reference number to access the frame list for that segment
- The editor can also access any frame, insert new frames, copy frames, delete or reorder frames
- A prompted graphics editor allows the author to change the size, position, rotational angle, and color of an image
- The graphics component continually supplies the author with prompted information as to what options are available during graphics develoment and editing.

Response Analysis

- Interactive questions include touch (mouse, light pen), multiple choice, true/false, matching and constructed response
- Author can set provisions for key words, spelling tolerance, synonyms and order of input
- Time-delayed response analysis in supported

Computer-Based Management/Utilities

- The management system (CMI) directs a student through the curriculum while generating assignments contingent upon students skill level
- The system scores tests and records completed assignments and the results of each
- CMI provides data collection and analysis capabilities for evaluating the effectiveness of instruction and tests

- The system is capable of monitoring and evaluating the effectiveness of the entire training program
- Reports are available in both display and hardcopy formats
- Access control within ISS is provided at several levels, ranging from unlimited access to restricted access
- Layers of protection are provided in each access group
- Students and instructors have the capability of sending on-line messages to each other
- System provides printed listings of frame content and logic
- Users must enter specific ID followed by a specific, changeable password to enter program/system

Software Interface

- System able to copy frames from any module or section the author has access to
- Author has access to programs written in the programming language of the system

Prompting

- Menus allow control of instruction events by permitting students to select lessons, segments, frames, tests, etc.
- Templates and prompts continually supply the author with information as to what options are available and develop the entire courseware program

Costs

- The system is owned by the government and managed through the Air Force Human Resources Laboratory (AFSC)

AUTHORING LANGUAGE

InterAct
Ashton Interactive Training Corp.
P.O. Box 5619
Vestal, NY 13851
(607)748-4015
Contact: Thom Ashton

Introduction

InterAct is a microcomputer-based concurrent authoring system which was introduced into the market in November 1981. Courses may be developed with the system alone or interfaced with external programs, text files, graphic images, video segments, and animated presentations for improved development latitude.

Hardware and Software Requirements

- IBM PC, XT, AT or 100% compatible with minimum 512K RAM
- Two 360K disk drives or hard disk
- MS or PC DOS 2.0 or later
- CGA required for color and graphics
- Sony PVM-1271Q required for interactive video and computer display on one screen
- DECtalk for speech capabilities
- US Video OVERLAY 110 PC-Video overlay required for videodisc interface
- MS or PC DOS 2.0 or later
- Digitizers that can display bit-mapped images on screen can be supported through interacts screen captive facility and incorporated in lesson
- Interact can also use a routine (must be created) to react bit-mapped files created by a digitizer

Graphics

- CGA and EGA graphics supported
- Internally generated text, graphics, and animation
- Interface with external text files, graphic programs, video segments and animated presentations
- System integrated tightly with Show Partner graphics presentation package. Features such as zoom, scale, and rotate can be accessed through Show Partner
- Maximum Resolution 640x350 (EGA Board) with 16 colors
- Screen capture utility
- Mouse driven graphic editor
- Animation script editor
- Manipulate color of text drawn from external files

Branching

- Unlimited
- Able to access previous page

Editing

- Any ASCII text or screen editor may be used
- Internal line editor with automatic restructuring for ability to insert or delete
- Mouse driven graphic editor

Response Analysis

- Five multiple choice, five match expressions
- Each expression can be defined by as many as 255 characters of possibilities, separated by delimiters
- Each possibility can be wild-carded

Computer-Based Management

- Lesson Question/Response Statistics Report (print)
- Student Statistics by Student Report (print)
- Student Statistics Report by Lesson (print)
- Reports require purchase of records statistics management system

Software Interface

- Runs programs written in any language but Basic
- Imports text files, video segments, graphic images, and animated presentations
- Concurrent with micro-based programs

Prompting

- Prompts and menus may be skipped
- Context-sensitive prompts and menus, generated based on "what ifs"

Costs

- $3875 perpetual use and license to distribute courseware developed as licensee sees fit
- Records statistics Management System $750 (requires dBase III) and $825 (run-time version)
- Random Test Generator option $1495
- Videodisc controller option $1295
- Telephone support and enhancements free first year, $200 subsequent years

AUTHORING SYSTEM

MAESTRO/pc Authoring System
Aim Tech Corporation
77 Northeastern Blvd.
Nashua, New Hampshire 03062
(603)883-0220
contact: James A. DiGregorio

Introduction

Maestro/pc is an icon based, microcomputer authoring system which runs under Microsoft Windows software. The system incorporates a process of first building the structure of a course from a library of "building blocks" and then added content to each element in the structure. In this highly visual process, icons are used to represent the "building blocks" and dialog boxes are used to fill in the content. Microsoft Windows act as a layer between developed courseware and the graphic and input/output devices connected to your hardware. As well as producing a highly visual and interactive screen, this process permits developed courseware to run on any display device that has a Window's driver. A mouse is used as the main input devise for this system.

Hardware and Software Requirements

- IBM XT, AT or 100% compatible
- 640K RAM
- Hard disk
- Windows compatible mouse
- EGA graphics board
- U.S. video overlay 110 for interactive video
- Supports the following videodisc players: Sony LDP-2000, Panasonic TQ-2023F optical disc recorder and player, Pioneer LDV 2000, LDV 4200 and LDV 6000A, McDonnell Douglas LFS 4400 and TEAC LV-200A videodisc recorder
- A simple program must often be written to convert the files created by a digitizer into Maestros file-format for bit-mapped graphics

- Microsoft windows version 1.03 or later and MS-DOS
- Any display device (monitor) and printer that has a windows driver

Graphics

- Free form drawing is supported
- Circles, boxes, text, etc. can be presented at a very high display speed
- Custom displays may be created and stored in icon library
- Library of pre-constructed icons and structures
- 640x200 resolution with video display
- Without video any resolution supported by graphics board and monitor is supported (e.g., 640x350 with IBM EGA)

Branching

- Unlimited, the number of branches possible is limited only by the memory size of computer

Editing

- Hot spots for mouse inputs, location and size of windows, etc., can be visually defined by an area editor
- Any text editor that creates ASCII text files can be used
- Full function graphics editor
- Images created by other microsoft windows compatible editors can be ported to the Maestro editor through a clipboard facility
- Color editor allows author to mix individual entries of a color palette
- Cut and paste editing for graphic images
- Videodisc editor allows the author to browse through the videodisc and mark certain frames. The system then determines the frame number and automatically inserts it into the content editor field

Response Analysis

- Answer parsing
- Unlimited number of responses
- No limit to characters per response
- Anticipated incorrect responses

Computer-Based Management/Utilities

- All student responses can be captured and saved for analysis in real-time or off-line
- The author must design his own report formats and analysis

Software Interface

- Maestro can execute other Maestro programs which allows for team authoring of large courseware

Prompting

- User driven system
- Library of icons available to build structure of the course
- The icon is selected with a mouse and the actions are performed through pull-down menus
- Custom structures may be developed and assigned an icon in the library

Cost

- $799 Authoring System (single user)
- Delivery system license free and may be copied and distributed by the licensees at no charge
- $50 preview software license which has the functionality of the full fledged authoring system except for the ability to save courses it creates

. $250 one year product support license which includes software and documentation updates and a telephone hot line

Training

. $5,500 five-day course at customer site (5 students or more)

. $600 five-day course at AIMtech (per student rate)

. 1-day seminar at AIMtech (per student rate)

Notes

. A joint project with MIT will port Maestro onto Digital's VAX Stations and IBM RT's by 3Q/1988

. Apple Macintosh and Macintosh-II versions will also be available by 2Q/1988

. AIM tech will begin a project in late 3Q/1987 which will allow Maestro to generate code for and run with the Army's EID's system

AUTHORING SYSTEM

McGraw-Hill Interactive Authoring System (MHIAS)
McGraw-Hill Training Systems
1221 Avenue of the Americas
New York, NY 10020
(212)512-4757
Contact: Kathleen A. Gilligan

Introduction

The McGraw-Hill Interactive Authoring System is a menu- and prompt-driven system which requires no programming skills and was introduced in March of 1983. Using the screen capture utility, the system can copy exact screen images (text or graphic) from mainframe or MS-DOS programs, directly into the authored lesson. A screen compression utility allows up to 300 screens per disk for increased branching capabilities, course flexibility, and individualization.

Hardware and Software Requirements

- IBM PC with a minimum 256K RAM and 2 double-sided disk drives
- IBM XT with a minimum 256K RAM and 1 double-sided disk drive
- PC DOS
- Mouse is strongly recommended for graphics utility
- Serial port is required for interactive videotape
- IBM PC and XT compatibles are generally not supported

Graphics

- Graphics utility based on PC Paintbrush
- Circles, disks, rectangles, and 10 different line weights
- Freehand drawing and custom pattern development
- Color-fill patterns and "spray painting"
- Tilt, rotate, flip and overlay images (author feature only, not available to user)
- Zoom in for detail work (author feature only, not available to user)

- Drawings are saved directly into a lesson, so the author can work with both Text and Graphics editors
- Keyboard or mouse used to select drawing commands from pull-down menu
- Reversing colors
- Flooding with a color or pattern
- Unlimited graphics library

Branching

- 16 branches in any direction
- Multi-dimensional branching
- Branch to any DOS-based programs or programs written in Basic, Pascal, and others

Editing

- Full text and graphics editors
- WYSIWYG style editors
- Thirteen fonts, seven letter styles and nine point sizes
- Move and copy sections of a drawing or pattern
- Able to edit screens during presentaion

Response Analysis

- Only one correct response possible
- Fill-in, multiple choice, matching, and application simulation

Computer-Based Management/Utilities

- Record management tracks performance results for up to 10 users on a lesson disk with feedback on both individual and group bases, in statistical and graphic formats
- Provides item and time analysis
- Generates personal student performance reports

Software Interface

- Interface with and DOS-based programs or programs written in Basic, Pascal, and others
- Able to capture screens from MS-DOS or mainframe application programs and bring them into courseware. Any screen that can be printed can be captured.

Prompting

- Menus, prompts, and on-line help guide author through development process

Costs

- $595 authoring system
- $250 optional screens capture utility
- $99 optional lesson consolidation utility

Notes

- A free demonstration disk is available from McGraw-Hill

AUTHORING SYSTEM

MicroTICCIT
Ford Aerospace & Communications Corporation
Western Development Laboratories Division
10800 Parkridge Boulevard
Reston, Virginia 22091-4335
(703)620-6806
contact: Gerald Moore

Introduction

MicroTICCIT is a fully integrated software and hardware system for developing computer based training (CBT). The system is comprised of a high resolution workstation, full-feature authoring system and computer-based courseware management system. The Hi-Res Workstation is an IBM PC-AT with 992x480 pixel screen resolution and peripherals which include a graphics digitizer, mouse, and videodisc player. The ADAPT Authoring System operates at a variety of levels, depending on the experience of the author and complexity of the courseware. The Management System provides a wide array of detailed reports for both instructors, students, and authors.

Hardware and Software Requirements

- MicroTICCIT is an integrated hardware and software system that features an IBM PC-XT as the host
- Peripherals such as a mouse, digitizer, high resolution monitor(s), videodisc player, and light pen are supported
- MicroTICCIT runs in its own operating environment that calls for certain MS DOS functions
- The workstation can support up to 10 terminals
- The workstations can be linked to a data general microprocessor host

Graphics

- 992x480 pixel resolution (resolution can be custom tailored for greater sharpness)

- Complex line drawings and photographs can be entered via a digitizer. All graphic editing features may then be utilized to enhance the digitized graphic.
- Pop-up style menus
- Geometric and free-form drawing
- Simultaneous display of 16 colors from a 4096 color palette
- Individual pixel manipulation
- Rubberband patterns and color fill
- Graphic inputs devices include mouse and light pen

Branching

- Branch to any location (unlimited)
- Unconditional to complex conditional branching
- Automatic or author defined branching
- Authors are branched directly to specific help screens for the function from which they are working

Editing

- Full text and screen editor with word processing features
- Authors create text displays exactly as they will be presented to student
- A multi-level editor integrates text, graphics, video and audio without requiring authors to do computer programming
- Automatic debugging features for syntax errors in code

Response Analysis

- Multiple choice, true/false, arithmetic expressions, and areas on screens

Computer-Based Management/Utilities

For Instructors

. Displayed or printed reports

. Reports include: student name, student ID number, total amount of time spent by each student on the lesson, the average time spent by all students, the number of times student attempted the lesson test, the class average for test attempts, the student's score for the lesson, and the average score for the class.

. System can predict when each student will complete a course based on class averages and past performance

For Authors

. Students can leave on-line notes or messages to aid the author in revisions

. Authors can examine types of student responses for any practice or test item and analyze these responses for problem areas in course development (item analysis)

For Students

. By analyzing a diagnostic pretest, the system can determine students entry level and automatically tailor the course accordingly. The student is then shown this individualized "lesson plan" in the form of color-coded maps or menus.

. Specific learning prescriptions may be formulated on the basis of test results, peformance on individual practice exercises, instructor inputs, or combinations of all three.

Software Interface

. Author can access programming language at any stage

. Commands in the authoring language allows the system to send key strokes and strings of code to other software programs. This includes operational software on a DECVAX mainframe.

Prompting

- Authoring environment is menu-driven; but can be bypassed
- Built-in templates provided; others can be developed using the authoring language

Cost

- $40,000-$50,000 estimate for a complete workstation featuring an IBM PC-AT, two high resolution color monitors, a desk top digitizer, a videodisc player, mouse input, authoring system, and management system

Notes

- The MicroTICCIT System can send a string to the DECVAX that will allow it to "activate" certain sections of the operational software. While operational software is running, MicroTICCIT will monitor student input and produce any messages that are needed. After the operational software is run the MicroTICCIT system resumes operating as a stand-alone system. A terminal emulator must be used for this feature to be used.

OASYS

AUTHORING YSTEM

The OASYS Authoring System
ON LINE Products Cor poration
20251 Century Blvd.
Germantown, MD 20874
(301)428-3700/(800)922-9204
contact: Deborah J. McCaffrey

Introduction

OASYS is an authoring system which runs with and generates code for the Pilot Plus authoring language. The system features object oriented authoring where the designer simply selects segments of video, graphics, and audio from database catalogs with a mouse. The segments are then placed directly into the appropriate section of the course. OASYS features a two-monitor standard that supports a color monitor for text and simple graphic output and a composit monitor for displaying detailed graphics and video. The system supports CD-I and CD-ROM.

Hardware and Software Requirements

- IBM XT, AT or compatible with 640K RAM and 1 floppy drive
- A hard disk is recommended
- Also runs on Matrox EIDS and SonyView
- IBM display adapter and monitor (CGA or EGA)
- GL512 graphics card with onboard genlock and videodisc controller mouse (for authoring)
- Sony PVM monitor for videodisc presentations
- Most models of Sony, Pioneer, Panasonic, Hitachi, and Matrix videodisc players supported

- Most RS-232 or IBM game port devices can be interfaced
- Fully supports GL512 graphics board and InfoWindows and New Media Graphics boards for presentation only
- Supports digitizers that can create files in the bit mapped format of the GL-512 graphics board

Graphics

- 640x480 resolution and 16 colors per screen from a palette of 4096 using GL512 graphics controller (available from ON-LINE)
- InfoWindows with EGA 16 colors per screen from palette of 64 and 640x480 resolution using New Media Grapics Card (for delivery only)
- Complete graphics paint system using bit pad mouse or frame grabber
- Able to "zoom in" 4X on any quadrant of the display screen

Branching

- By mouse, touch, or other positional device input
- By time variable or delay
- Random branching
- Branch by computed value
- Branch to anywhere in lesson (unlimited)

Editing

- Full screen text editor with automatic work wrap
- Select from 10 font styles or define new fonts
- What you see is what you get (WYSIWYG) positioning, sizing, color selection and border design
- A bit tablet or mouse driven graphic editor which can create and modify RGB graphics

- Single-pixel control
- Graphic editor controls size, aspect, color, tint, positioning and overlay

Response Analysis

- Number of responses limited only by template
- 128 characters per response
- Unanticipated answer handling
- Wildcards

Computer-Based Management

- System generates sequential text files (log files) which can be imported by most conventional database application programs (dBase, Lotus 1-2-3, etc.)
- Custom Computer Managed Instruction (CMI) programs are available

Software Interface

- Read/write sequential/random files
- Execute any MS-DOS program, pass parameters
- "Hook" provided for special call interface with memory-resident applications
- 2-way parameter passing/returning values

Prompting

- System provides preformatted templates where author is prompted (in text) to fill in each item of required information
- Custom-developed templates can be produced
- Templates can be developed by writing code in Pilot Plus authoring language

Cost

- $3000 perpetual license (note: OASYS must run with the Pilot Plus authoring language which must be purchased separately)
- $5000 perpetual license for OASYS, Pilot Plus authoring language, enhanced graphics and font editors
- $700 for audio editor
- $100 per workstation for presentation system

AUTHORING LANGUAGE

PC/Pilot
Washington Computer Services
2601 North Shore Road
Bellingham, WA 98226
(206)734-8248

Introduction

PC/Pilot is an authoring language designed especially for instructional software development. Because it is a language, it has the flexibility to handle complex logic. In contrast, an authoring system may limit a developers creative freedom by offering only certain types of instructional tools and images. PC/Pilot, and most other authoring languages, require programming skills.

Hardware and Software Requirements

- IBM PC or compatible with 256K RAM
- MS or PC DOS 2.0 or higher
- CGA or EGA required for color and graphics
- One 360K disk drive
- Supports any digitizer that creates files in a PC Paintbrush or other popular graphics program format

Graphics

- Bit-mapped graphics via built-in paint utility
- Capture images from other software
- Turtle and Vector graphics
- Full or partial screen wipes and fades
- APA graphic operators - line, arc, circle, box, paint...

Branching

- Unlimited paths
- Branch on answer judging or arbitrary program logic based on numeric or string expressions
- Time delay branching

Editing

- Line editor
- Full screen text or text and graphics editors combined
- Character editor permits author to redefine the bit pattern for any standard characters
- Font editor can customize the provided fonts or create custom fonts
- Re-define keyboard layout
- Editor contains a macro facility (a pre-coded sequence used to perform a common action) that prompts the author for any necessary information

Response Analysis

- Unlimited number of responses and up to 256 characters per response
- Six types of wild card
- Unlimited use of wildcard combinations
- Input can be in any location, color, or font

Computer-Based Management

- Supports full student record keeping on disk or network file

PC/Pilot

Software Interface

- Programs in other languages can be called directly from within a PILOT program
- Capture images from other software programs

Prompting

- Prompt-driven authoring system is available for non-programmers
- Pre-formatted menus and templates available via macroprocessor using supplied or user-written macros
- Menus and templates may be by-passed

Costs

- $200 perpetual license
- $2000 site license
- Version upgrades $100

Note

- Prompt-driven authoring system available for non-programmers
- Advanced featured library ($300), PILOT tutorial programs ($125) and font library available

PMS

AUTHORING SYSTEM

Production Management System (PMS)
Computer Science Corporation
Defense Systems Division
Post Office Box M
Fort Eustis, VA 23604
(804)873-1024
Contact: Bill Stembler

Introduction

The PMS consists of a series of computer programs contained in a set of ten computer diskettes. These programs automate the development, production, and programming of interactive training materials and information. PMS was developed to meet the needs of IVD and has been refined to handle some CAI as well. PMS is the Army's interim standard for the EIDS system. The actual software for the EIDs system is EIDS Assist. Assist uses the IV-D authoring system as a nucleas and has created a special interface to make it compatible with EIDs. All courseware developed with PMS will be converted to EIDS ASSIST.

Hardware and Software Required

- PMS can run only under machines with 8-bit Architecture and the CMP operating system

Graphics

- Pre-developed geometric algorithms (circles, squares, triangles, etc.) - limited graphics set available
- Variable fonts
- Able to expand/compress graphics (symbols, characters, shapes)
- Graphics storage library
- Overlay text, graphics, and video

Branching

- Branch to an external programming language
- Branch based on elapsed time
- Wildcard branching
- Users can go forward, backward, return to menus, or decision points, exit, suspend, or add place marks at any time

Editing

- Copy text and graphics from one display to another
- Limited word processing and text editing capabilities
- Storage and recall of user defined phrases and graphics

Response Analysis

- Multiple choice (up to 8 alternatives per screen)
- Completion with selective judging (anticipated answers, letter substitutions, and wildcards)
- Numeric response with error margin
- Program lock system, requires intervention to unlock
- User can add marginal notes or deficiency reports to be used at a later time
- Input via keyboard, mouse, light pen

Computer-Based Management

- Separate data file created for each students records
- Student records include: name, SSN, test scores, time on test, time per lesson, student resonses
- Results and time can be displayed to user
- Up and down load student records

- Course records include: average time to complete, number of students, failures, data summarization for a single subject

- Software is provided to transform data and run the programming errors, to flow through a lesson, and to note deficiencies as users go through material

Software Interface

- Jump to an external programming language (hook function)

Cost

- The Army owns unlimited internal distribution of this product

Prompting

- Most of the user-friendly prompts are to be added in future additions

- Storyboards are structured to allow for storage of reference information, scene descriptions, text or audio needs and program sequence information. Changes are easily made. PMS contains additional production management utilities to aid courseware development.

AUTHORING SYSTEM

Quest Authoring System
Allen Communication
140 Lakeside Plaza II
5225 Wiley Post Way
Salt Lake City, Utah 84116
(801)537-7800
contact: Marty Newey

Introduction

Quest is a micro-based authoring system first introduced in November of 1984. The system offers prompted authoring or the ability to interface with the programming language for developing more complex interactions. Quest is written in a Pascal-like language which allows the system to access any program written in any compiled language. The systems editors allow the creation of text, graphics, video, and animation at any pixel location. Along with its own graphic editor, Quest is able to import outside graphic packages such as PC Paintbrush. Allen Communication offers fully integrated interactive systems.

Hardware and Software Requirements

- IBM PC, XT, AT or compatible with a minimum 384K RAM
- MS or PC DOS
- CGA, EGA or Tecmar Graphics Master Boards
- Supports any digitizer that creates PC Paintbrush Plus type files
- Fully Integrated systems available from Allen Communication using the following equipment:
  - Video and graphic overlays: Val Microkeyer, Visage, MIC-2000, IBM InfoWindow, or Sony View
  - Videodisc players: Pioneer 6010/6000/1000/1001/4000/700/900, Sony 1000A, 2000/1, 2000/2, 2000/3, 2000/4, 2000/5, Hitachi 9500, Magnavox 8040
  - Color monitors: Zenith ZVM 135, Sony PVM 1271 Q, Sony PVM 1910, or IBM InfoWindow
  - Mouse, light pen, and touch screen available

Graphics

- The built-in grapics editor offers bars, arcs, rectangles, ellipses, and freehand line drawing
- Ability to mirror, scale, rotate, or move graphic objects or groups of objects
- Screens created with outside graphic packages such as PC Paintbrush can be used in lessons
- Graphic library
- Graphics can be created at pixel level detail or at multiple pixels with the cursor
- Bit-mapped shapes can be created
- Multiple shapes can be animated on the screen along a path
- The author can determine the time at each location, the speed and number of shapes included in the animation
- Two or more shapes can be cycle-animated at a specified location
- Any number of windows can be overlayed
- 640x400 maximum resolution with Tecmar Board

Branching

- Branch to any location (unlimited)
- Ten branch types which include:
  - unconditional
  - conditional (based on value of built-in or defined variables, e.g., score, right/wrong)
  - expression (based on any mathematical equation)
  - call (a frame in lesson)
  - return
  - random (for simulations)
  - call lesson (access to external lessons)

- call program (access external programs in any compiled language)

- repeat and end

. All branches can be timed

Editing

. The creation of text, graphics, video, animation, etc. are done at any pixel location

. Anything created can be edited using on-line editing

. Author can insert and delete text, change the text color, size or font

. WYSIWYG style editors

Response Analysis

. System accepts words, characters, numbers, or positions on the screen

. Wild card characters

. Author can search for keywords, characters, word roots, synonyms, phonetic spellings, case-dependent/independent spellings, word order, phrases, and subsets

. Numeric analysis which includes tolerances

. Input via keyboard, mouse, trackball, and touch screen

. Each answer can be weighted for scoring

. The number of correct, incorrect, neutral, unexpected and/or time-out answers per interaction is limited only by frame size

. Positional analysis

Computer-Based Management/Utilities

. Individual student reports include amount of time to complete lesson, number correct, incorrect and percentages

- Lesson reports keeps track of the time, number correct, incorrect, and percentage for each frame in lesson
- Students can be registered and assigned lessons or given freedom to take any lesson
- Able to printout lesson logic, screen displays, graphic libraries, and reports

Software Interface

- Able to execute any external program in any compiled language and return to lesson
- Able to execute any additional course on disk and return to lesson

Prompting

- On-screen prompt line is changed and updated based on the function the author is performing
- Author-developed templates available

Costs

- $1295 authoring system and presentation system, perpetual use
- $20-$100 each for additional presentation sytem
- 90-day maintenance and update warranty included with standard license. Extended warranty available at extra cost
- $500 a day for off- or on-site training courses
- Site licenses, royalty agreements, and educational discounts available
- Sample integrated interactive systems:
  - Computer: IBM PC XT/AT, 640K, 20 meg hard disk, on floppy
  - Video interface: Overlay and interface board, model 1125

- Color Graphics Card: enhanced color graphics adapter (EGA)
- Monitor: Zenith ZVM 135, 14" color monitor
- Videodisc player: Pioneer LD-V4200
- Quest Authoring System

System Cost: $5190

SAM

AUTHORING SYSTEM

SAM (System for Authoring Microtraining)
LEARNCOM Division of Sandy Corp.
215 First Street
Cambridge, MA 02142
(617)576-3100
contact: Greg McDonald or David McGovern

Introduction

SAM is a prompted authoring system which is written in Pascal with advanced graphics in Assembly. The system is geared toward the non-technical course developer but allows the designer a good degree of creative freedom. SAM provides an additional system that interfaces woth videodisc (SAM:VDISC).

Hardware and Software Requirements

- IBM PC, XT, AT or 100% compatible with a minimum 256K RAM
- Hard disc strongly recommended for authoring
- CGA or EGA and RGB monitor required for color and graphics
- DOS 2.0 for later
- Supports Digitizers that create PCX files (PC Paintbrush style) and support EGA style graphics

Graphics

- 16 color, bit-mapped graphics
- Graphics library capability
- Input using mouse, light pen, digitized tablet and keyboard
- 640x350 resolution and 80-column text
- Create unlimited templates or model pages

- Arcs, rectangles, circles, ellipses, straight and diagonal lines, polygons, pie charts, free-hand sketching
- Graphics animation over any author defined pathway at any speed
- Use graphics created with PC Paintbrush graphics program
- Fast flood filling of any screen area
- Move any graphics figure partially or completely off screen during animation or at any other time

Branching

- Branch to any location (Unlimited)
- Branch on author defined time delay
- Branch on a single key, fill in, computed answer and video interrupt
- Random branching to any screen/page in an author defined role of screens/pages

Editing

- Full screen integrated text, graphics, video and branching editor
- Multiple character sizes and fonts
- Self erasing screens for windowing
- Directory of screens
- Context specific author help
- Unlimited number of page overlays
- Complete word processing features, including word wrap, center text, insert typing, etc.

Response Analysis

- 20 different variables may be used
- 20 questions per screen
- Learner response up to 80 characters
- 234 characters for alternative
- List answers in any order
- Multiple correct answers
- Numeric responses judged based on whether the fall into an author defined range

Computer-Based Management

- Learner progress reports
- Director of learners
- Printed student and group reports including raw score, percent score, tries per item, elapsed time, record of responses and others
- Learner password required for entry into lesson (optional)
- Multiple learners on same disc
- Adapt files to ASCII format

Software Interface

- Capture screens from other application software and bring them into the lesson
- Able to read in existing external text files (ASCII)
- Can input graphics created with PC Paintbrush

Prompting

- Full screen available for any author defined prompting
- Template screens are system or author created

Costs

- $3500 first year, $875 subsequent years
- SAM:VDISC $4000/yr, $875 subsequent years
- Quantity discounts available
- Upgrades, enhancements and unlimited phone support free of charge

AUTHORING SYSTEM

Shelley
ComTrain, Inc.
152 Mill street
Grass Valley, CA 95945
(916)273-0845
contact: Wallace P. Judd

Introduction

Shelley is a concurrent authoring system which creates and edits lessons in three modes: menu-driven system, command-level editing and Shelley language programming. These modes are designed to accomodate developers with different levels of programming skills. The program language requires the user to have definite programming skills.

Hardware and Software Requirements

- IBM PC, XT and 100% compatible with a minimum of 128K RAM
- DOS 2.0 or later
- Hard disk strongly recommended for authoring
- Shelley can run concurrently with almost any program designed to produce digital images and can input the files created by the program

Graphics

- Input from internal draw program or from PC Paint or PC Paintbrush
- 640x200 monochrome, 320x200 color mode graphics output
- Animation, lines, window graphics
- Read and write to pixel mode grapic screens
- Text available in 254 colors
- Scroll or paste text in a window

Branching

- Gosubs may be nested ten deep
- Menus can branch to other menus, without limit
- Branch to any file from menu
- Branch to any designated spot in any author file
- Multiple conditionals evaluating 1-20 expressions, case statements, if-then, repeat loops and process definition

Editing

- Full window editor in menu driven mode
- Full screen editor in program mode
- Menu-driven authoring systems produces Shelley code files
- Shelley code files are editable ASCII text files and may be printed for hard copy
- Non-printing characters may be coded as printing characters

Response Analysis

- Branch on different text responses
- Define number of times before error and/or help
- Input modes include: multiple choice, string input, cursorable menus, characters, and cursor movement
- Response timing allowed to nearest second
- Allows author to analyze free response answers

Computer-Based Management

- Author-definable record format for student/course files at virtually any level of detail
- Text or numbers may be written to or read from the records in files

- Files may be read and written randomly or sequentially
- Multiple files may be open simultaneously
- Can measure time intervals in minutes, seconds, or tenths of seconds with four separate clocks
- Can record elapsed time per lesson, number of correct first tries, percent errors, and virtually any additional type of student, group, or course data

Software Interface

- Run an application program concurrently
- Up to nine different external modules may be linked at one time
- External C or Assembly programs may be linked to Shelley
- External programs may be accessed by authors within Shelley

Prompting

- Three levels of authoring - full menu-driven, text authoring, and programming
- Shelley can prompt a student in any portion of an application program (e.g., system can prompt a student on how to input digitized graphics)

Cost

- $3500 for authoring system and $5 for presentation system
- $10,000 for site license (1 year free updates and ten hours consulting during subsequent years. Annual support and upgrade fee after first year is 20% of initial cost.)
- Presentation systems with a site license are $5 per workstation, per year, without copy protection
- $75 for an examination package (DOS Sampler, Trial edition authoring disk and documentation)

Note

- Shelley can run concurrently with a mainframe application program by interfacing the microcomputer and the mainframe with a terminal emulator program. While the mainframe program is running, Shelley will control the pace by monitoring student input and display instructional material and prompts as needed. Shelley can run concurrently with most mainframe applications but each situation must be handled on an individual basis.

- ComTrain is presently in the process of upgrading Shelley to the IBM System/2 equipment, but a release date has not been announced

AUTHORING SYSTEM

Summit Authoring System
Conceptual Systems
1100 Wayne Avenue, 12th Floor
Silver Spring, MD 20910
(301)589-1800
Contact: Steven Okonski

Introduction

Summit is a menu driven authoring system written in Assembly Language and introduced in this version in June, 1987. The system's editors enable the designer to simultaneously create and view lesson display screens exactly as they will appear to the student. Summit can create up to 1,000 lesson screens on a single 360K disk.

Hardware and Software Requirements

- IBM PC, XT, AT or 100% compatible
- 320K RAM (plus 128K if EGA used)
- 2 disk drives (floppy or hard)
- CGA or EGA
- Supports any digitizer that creates PC Paintbrush type files

Graphics

- Up to 640x350 resolution in 16 colors
- Creates lines, boxes, circles, ellipses, arcs, and points
- Create graphics libraries, custom character sets and custom fonts
- Can load bit mapped graphics files from other programs
- Input via mouse and/or keyboard
- Windowing abilities

- Digitized graphics can be inputted into courseware if they are in a PC Paintbrush type file or if the scanner can display the image on the monitor, allowing Summit's capture utility to take a "picture" of it

- Can "zoom in" quickly on any graphics created with Summit's command based graphics editor. Graphics created with PC Paintbrush are more difficult, but usually can be done or a simulated zoom can be created

Branching

- Unlimitd number of directions

- Timed branching

- Branch an answer judgment, score, keypress, computation, and combinations of these

- Back-up and meanu branching

- Execute external programs, passing data if desired

Editing

- Full screen editor with optional word wrap

- Graphics screen and line editor

- Input and edit external ASCII files

- Automatic text compression (1000 screens per disk)

- Music and sound effects can be edited into lesson

- Examine and load parts of existing lesson screens

Summit

Response Analysis/Interaction

- Over 800 system and user-defined variables
- Fill-in-the-blank, multiple choice, matching questions and menus
- Mainframe input screen simulations
- Anticipated incorrect answers and current answer ranges (alphabetic and numeric)
- Time limit for responses
- Remap keys used for input
- Input via mouse, keypress and touch screen

Computer-Based Management

- Student log-on with password
- Track usage, sessions, time spent
- Log responses to questions, answer judgement, time spent on screens
- Generate printed reports showing above items

Software Interface

- Capture screens from other programs
- ASCII file inport/export abilities
- Run other programs from within lesson

Prompting

- Create questions by using templates or your own structure
- Menus and screen bottom prompts
- Many menus can be bypassed

Cost

- $2500 Authoring Systems Package, perpetual use
- One day training session and three months user support (phone, mail, updates)
- Quantity discounts 25-45%
- $50 additional delivery systems
- $9500 site license
- $500/year continued support

AUTHORING SYSTEM

Teachers Aide
Selection Systems, Inc.
2731 77th Ave. SE
Suite 201
Mercer Island, WA 98040
(206)236-2700
Contact: Bob Cullen

Introduction

Teachers Aide is a concurrent authoring system, with pop-up menus and windows, screen creation and an optional authoring languge. This "What you see is what you get" format allows for the speed and ease of a system, with the power and flexibility of a language. The concurrent feature permits training screens to appear on top of actual software, allows authors to test each learners input before letting it pass through to the software (shell function), or send a series of author-defined keystrokes to stimulate the software automatically. The concurrency feature can operate with microbased software in a standalone mode and with mainframe software if the microcomputer is used as a terminal. All training information will, however, have to reside in the microcomputer database.

Hardware and Software Requirements

- IBM PC AT and compatibles running MS or PC DOS 2.0 or later
- 256K RAM for color characters and 320K for bit-mapped graphics
- Supports digitizers that create PCX files (PC Paintbrush style)

Graphics

- Circles, lines, dots, ellipses, boxes, stripes, fill patterns
- Import PC Paintbrush created images
- Graphic library
- Worm Drawing

- 16 colors for borders, 8 colors for background, and 16 colors for foreground
- Graphics obtained from PC Paintbrush may be "Zoomed in," scaled and rotated using PC Paintbrush functions. Graphics created with Teachers Aide do not have these capabilities.
- Maximum Resolution 640x200

Branching

- Up to 50 branches per question
- On Demand User exits

Editing

- Full screen editor
- File editor
- Re-assignment of certain keys
- Editors are in a menu driven WYS/WYG style

Response Analysis

- True/false, menu/multiple choice, type answer into a field, special key entry (such as cursor control keys), type a matching sentence
- Unlimited number of responses
- 80-characters per response
- Question extension (multiple tests on one answer)
- Mathematical analysis on learner entries
- Answer parsing
- Timed responses

Computer-Based Management/Utilities

- Serving utility program reports student progress
- Files can be compressed to fit more information per disk

Software Interface

- Import any images created with PC Paintbrush
- Concurrency with other programs

Prompting

- Menus and "pop-up" windows
- Speed keys allow input of certain functions with one keystroke
- WYSIWYG (what you see is what you get) menu driven interface enables authors to see their screens while they are creating them

Costs

- $3500 yearly license
- $5000 first perpetual license
- $2500 second perpetual license
- $1500 third-fifth perpetual license
- $1000 sixth or more perpetual license
- Presentation disks are free of charge
- First six hours of support per license free
- $600 per day for additional on-site support
- 10% of purchase price per years for updates and revisions, first 6 months are free

Notes

A new compact version, Teachers Aide[1] (TAone) is also available. This system is similar to Teachers Aide and has all but the most advances features. It employs the same menus, operation features, editing capabilities, and is upward compatible with full Teachers Aide. The features omitted include: videodisc interface, concurrency, bit-mapped animation, key re-assignment, user exits and answer parsing.

Costs

- $625 for perpetual license (small volume discounts available)
- $4 each for presentation disk
- $1500 unlimited replication license
- $10000 site license
- $300 per year for upgrades and 3 hours of telephone consultation

AUTHORING LANGUAGE

TenCORE Language Authoring System and TenCORE Assistant
Computer Teaching Corporation
1713 South Neil Street
Champaign, IL 61820
(217)352-6363
Contact: Steve Simpson

Introduction

TenCORE is an authoring language, in which the designer must use programming commands (based on the TUTOR language) to create all instructional features of the courseware. TenCORE Assistant is a menu-driven prompted authoring aid, which allows non-programmers to create basic interactive lessons without Programming TenCORE Language Commands. Employing the more complex features of the TenCORE language, however, requires a relatively high level of programming skill. Programmers can upgrade courseware developed with TenCORE Assistant by adding in TenCORE language commands. Courses developed with TenCORE Assistant require the TenCORE language authoring system for delivery.

Hardware and Software Requirements

- IBM PC, XT, AT, 3260 or compatible running PC DOS.2 or later
- 196K RAM, two flexible disk drives or one flexible and one hard disk
- Also runs on Compaq, AT&T PC, Zenith 150 and other compatibles
- Courseware deliverable on Apple II
- Supports IBM monochrome, CGA, EGA, Techmar and Hercules graphic cards
- Supports digitizers that create bit-mapped files in a PC Paintbrush graphics format

Graphics

- High resolution graphics (640x400 pixels)
- 256 colors per screen from a palette of 4096
- Graphics may be created with authoring language or through interface to PC Paintbrush

Branching

- Able to branch anywhere in lesson
- Branch after specified amount of time
- Branch based on student response time

Editing

- Full-screen graphics and line editor for text
- Text block saves and moves
- Global changes (able to correct or input information once and have it corrected throughout program)

Response Analysis

- No limit on the number of specific responses or use of special characters
- 128 characters per response
- Able to handle unanticipated responses
- Control number of times student can attempt a question
- Short answer, multiple choice/menu and true/false questions types
- Item bank and pre-constructed tests are available
- Feedback can appear anywhere on screen

Computer-Based Management/Utilities

- Records student scores, number of attempts per question, and time it took to complete lesson
- Student registration
- Next step in course/curriculum is prescribed for the student
- Student is automatically routed to next section of course

Software Interface

- Able to import text files created with word processing software
- Able to interface with an external program written in a programming language (Pascal or C) and incorporate it in a course

Prompting

- TenCORE Assistant and Language Authoring System offer pre-formatted menus and self-developed templates
- Templates and menus may be bypassed
- TenCORE Assistant offers menu-driven lesson construction

Cost

- $2000 TenCORE Language Authoring System, perpetual use
- $250 TenCORE Assistant
- $475 a year for system updates and hotline

Trillian

AUTHORING SYSTEM

Trillian Demo Generator Concurrent Authoring System 3.0
Trillian Computer Corporation
405 Alberto Way, Suite One
Los Gatos, California 95030
(408) 358-2761
Contact: Bill T. Sautter

Introduction

The Trillian Demo Generator Concurrent Authoring System is a MS-DOS based program development tool introduced in ths version in May, 1987. Trillian is actually an authoring language that provides the designer with a great deal of creative freedom. Programs can be developed for text or bit-mapped graphics dislay modes, and can run either concurrently with "live" software or simulate its operation. Full-featured concurrent animation is available for both bit-mapped graphics and text display modes. The system can produce and deliver mainframe, mini-, and micro-computer training on a PC via a terminal emulator. Audio-tape and remote control interfaces are provided.

Hardware and Software Requirements

- IBM PC, XT, AT or 100% compatible with a minimum of 256K RAM
- MS or PC DOS 2.0 or later
- Color or monochrome monitor
- Monochrome and CGA adapter
- Digitizers that produce files in any CGA graphic level program format are supported

Graphics

- Display pictures
- Create and modify bit-mapped graphics pictures
- Produce animated graphics and special effects

- Multiple font and clip-art libraries
- Pop-up windows with animated scroll in, scroll out text and pictures
- Overlay graphics on top of existing pictures
- Capture entire or portions of bit-mapped graphic screens
- Extract portions of graphics screens and files
- Measure coordinates and dimensions of pictures
- Read and write graphics pictures to disk
- Highlight and modify colors on screen

Branching

- Branch to any location (unlimited)
- Define multiple "hot-keys" for precise product simulation, branching control and course interruption
- Use IF-ELSE, REPEAT-UNTIL, WHILE, and other high-level constructs to control flow, execution, and iterative operations
- Run external MS-DOS programs from inside courseware
- Time delay branching

Editing

- Full screen text editor and grapics editor with draw facility
- Produce programs with a Concurrent Text Editor while "live" subject applications run in the background
- Delete, copy, and rename files
- Read, write, and append to ASCII files
- Create, read, write, and append libraries of text windows
- Author can be writing, test running and debugging courseware while the subject application is running

Response Analysis

- Unlimited; flexibility by line, character, field, screen, cursor position
- Analyze keystrokes before they are passed to subject application
- Interpret wildcard characters
- Keystroke-by-keystroke with optional timeout
- Buffered with multiple termination characters

Computer-Based Management/Utilities

- Read disk directories
- Encrypt files to prevent user viewing and tampering
- Record student responses for later playback and editing
- Compress text files to conserve disk space

Software and Course Interface

- Can read, write, and append to ASCII files
- Interface with other software packages
- Run external MS-DOS programs from inside courseware
- Overlay multiple course sessions and disk volumes

Prompting

- Constraint-free authoring controlled by designer
- Author-definable pop-up menus, custom and "Lotus-like" ring memos

Cost

. $6800 first license, perpetual use

. $3400 subsequent perpetual licenses

. Site licenses are handled on individual basis

. $69 Concurrent text editor

. $199 Graphics editor/mouse

. $99 Remote control unit

Note

Trillian can deliver VAX mainframe based training programs on a PC computer using a terminal emulator. The terminal emulator converts the keystrokes of the PC into a form that the VAX will understand. Once the mainframe program is running, Trillian can "screen" or monitor student responses allowing only correct answers to reach the mainframe program and provide feedback for incorrect responses.

Unison

AUTHORING LANGUAGE

Unison
Courseware Applications
475 Devonshire Drive
Champaign, IL 61820
(217)359-1878
Contact: Tom Schaefges

Introduction

Unison is an authoring language that was introduced in October of 1986. A tutorial is provided with the package to help the non-programmer take advantage of the flexibility of an authoring language. Unison Draw, a graphic companion, allows the author to create full color images through the use of a menu driven, mouse-based graphics editor After the image is created, Unison Draw will automaticaly write the authoring language program to recreate the graphic. The code is then copied directly into the lesson.

Hardware and Software Requirements

- IBM PC and 100% compatible with a minimum 256K RAM
- At least one floppy disk drive
- Two disk drives or hard disk recommended for authoring
- PC DOS 2.0 or later
- The language uses any DOS ASCII file
- Supports any digitizer that creates a PCX (PC Paintbrush) file format
- Microsoft or compatible mouse

Graphics

- Includes arcs, boxes, circles, lines, ovals, polygans, and text
- All graphic objects may be in color, outlines, painted, or filed
- Multiple text fonts available
- Input via optional draw program (Unison Draw) or by manual programming

- Input via optional draw program (Unison Draw) or by manual programming
- Supports most graphic cards in both text and graphics modes
- Maximum resolution 640x400 (Techmar card) with 16 colors, 1280x800 monochrome resolution with Wyse WY 700 card
- Unison can employ all. PC Paintbrush features including the scaling and rotating of graphics

Branching

- Unlimited branching based on user input or programmer-controlled criteria (response, score, etc.)
- Branching can be forward or backward with optional help sequences including "pop-up" help available

Editing

- Uses any word processing or text editing program that can create standard DOS ASCII text files (non-formatted)
- Unison Draw contains an object-oriented graphics editor with full control over drawing pen color, style, and pattern
- Full text editing capabilities are built into Unison Draw
- Interface uses pull down menus and WYSIWYG style editors

Response Analysis

- Unlimited number of responses, 120 character per response
- Automatic answer judging for synonyms, missing words, words out of order
- Any number of correct or incorrect answers
- Multi-word responses
- Optimal feedback and branching for each response
- Unanticipated responses may be recorded

Computer-Based Management

- Full record keeping capabilities including tracking and reporting of student progress

Software Interface

- External DOS programs can be called from within a Unison Author Language Program (the lesson is temporarily suspended while the DOS application is active)
- Full control over software interrupts including segment
- Offset register loading/reading allows the Unison author language to call any interrupt-service routine

Prompting

- Total flexibility in user developed menus

Costs

- $345 Unison Authoring Language, Perpetual Use
- $195 Unison Draw, Perpetual Use
- $429 Unison Authoring Language and Unison Draw, Perpetual Use
- Free, unlimited access to instant software updates
- Free telephone support for 30 days
- No royalties for distribution and not copy protected

AUTHORING SYSTEM

VAX PRODUCER, version 1.6
Digital Equipment Corporation
1500 Ardmore Boulevard
Pittsburgh, Pennsylvania 15221-4402
(412) 244-7875
Contact: Rick McCormick

Introduction

The VAX PRODUCER consists of two components: a visual component created by the VAX DRAW graphics editor, and an interactive/branching component created using the VAX DESIGN development language. VAX DRAW allows a designer to create scren displays and store them in a file called a Display Library. The VAX DESIGN development language is used to control the interaction with the user and what happens as a result. VAX DESIGN source programs are preprocessed and linked into a file containing a pseudo-machine language that is system- and address-space independent. Programs written in VAX DESIGN on a VAX/VMS or Micro VMS system can be run without modification on any system wih a PRODUCER Interpreter. The PRODUCER Interpreter reads from the pseudo-code file and Display Library to present the information and interact with the user. To use a mouse input and color images the IVIS Terminal must be used. VAX PRODUCER supports this terminal type when it is running the PRO/PRODUCERT Tool Kit (Terminal Emulator).

Hardware and Software Requirements

- Any valid VAX, Micro VAX (1 or 11) or VAX station 11 system running VMS operating system
- IMB physical memory

Graphics

- Arcs, polygons, circles, boxes, blocks, lines, and curves
- Text may be animated from one location or screen to another
- Graphics library
- Screen resolution contingent on monitor used, (e.g., VT-340 monitor - 800x560)

Branching

- Unlimited number of branching points
- Branch to other programs on the VMS system
- Able to backup to defined points in the program

Editing

- Line-oriented graphics and text editor
- Scan-oriented editor also available
- Characters may be positioned on the screen, centered, or displayed in blocks

Response Analysis

- Entire words or parts of words may be wildcarded
- Answer-judging packages -- a set of preprocessed source programs and package files which may be linked with VAX DESIGN applications. Included are routines for verbal and numerical answer judging.

Computer-Based Management/Utilities

- The system contains database files which contain user authorization, enrollment and performance information, in addition to application installation and usage data. These files can be read by other DIGITAL database management and report generating utilities to allow custom reports to be created.
- Routines to be used in the courseware for recording and accessing information in the database are contained in a library.

Software Interface

- Able to run and exchange information with other programs running under VMS operating system

Prompting

- System is not menu driven
- Templates can be created by author

Cost

Micro VAX

- $8900 VAX PRODUCER Authoring system and documentation, perpetual use
- $260 VAX PRODUCER Interpreter and documentation, perpetual use
- $450 PRO/PRODUCER Tool Kit (Terminal Emulator) and documentation, perpetual use

VAX 8800

- $51,500 VAX PRODUCER Authoring System and documentation, perpetual use
- $560 VAX PRODUCER Interpreter and documentation, perpetual use
- $450 PRO/PRODUCER Tool Kit (Terminal Emulator) and documentation, perpetual use
- The cost for other systems fall proportionally between the Micro VAX and VAX8800

APPENDIX C

IMAGE SCANNER MARKET SURVEY

APPENDIX C

IMAGE SCANNER MARKET SURVEY

Digitization of images for computer display, enhancement, and storage is accomplished with a device called an optical scanner. This discussion of optical scanners is particular to ASAS/ENSCE trainers, and is based on the following assumptions:

1. Scanners will be used to convert images such as maps and photographs into digital data for computer enhancement, modification, incorporation into computer-based training (CBT) software, and display on high-resolution, full-page monitors.

2. High resolution is essential to the ASAS/ENSCE trainer application, and no device producing less than 300 dots per inch (DPI) resolution was considered.

3. Color scanning is desirable but not essential to the ASAS/ ENSCE trainer application.

4. Optical character recognition (OCR) is not prerequisite to the ASAS/ENSCE trainer application.

5. Interest is in devices that interface with DEC computers, IBM personal computers or compatibles, and Apple Macintosh computers. Every device considered can interface with the EIDS standard.

6. Availability of support software for modifying and displaying images is desirable but not prerequisite to the ASAS/ ENSCE trainer application.

Background

Image digitizers may be grouped into two types by the input method used. One type uses a stylus, mouse, or other device with which a person manually traces a line drawing for digitization. Manual devices are inappropriate for the ASAS/ENSCE trainer application and were not included in this survey. The second type of device is an optical scanner in which light reflected from an image is focused and aimed at a photodiode array or charged coupled device (CCD) which translates analog voltage signals into digital data signals which in turn are stored on computer disk. Software is then used to display and modify the image.

Resolution has two aspects, pixel density and contrast. Pixel density is represented as dots per inch (DPI), lines per inch (LPI), or as a matrix of horizontal pixels by vertical lines. Three-hundred DPI is the minimum resolution necessary for photographic image representation. Contrast is represented as bit planes which produce levels of grey shading or color. Eight-bit machines can produce 256 levels of grey or 256 colors, which is the minimum required for photographic-quality images.

Summary of Findings

Optical scanners can be grouped into three types: roller-feed scanners, flatbed scanners, and tabletop scanners. The distinction refers to the method of scanning an image. Roller-feed scanners use a platen to move the image over the scan element. The disadvantage of this scan type is that scanned documents must be single sheets whose size is limited to 8.5 x 14 inches maximum in all devices surveyed. Flatbed scanners are similar to Xerox machines. The image is placed on a glass top and the scanner moves under the image. This scan type can accommodate larger originals and bound material, although the area of image scanned is normally limited to 8.5 x 14 inches maximum. Both the roller-feed and flatbed scanners are primarily intended for desktop publishing applications. They range in price from $1,095.00 to $6,000.00. All of the scanners surveyed of these types had a maximum pixel density of 300 DPI. Only the Howtek Scanmaster flatbed scanner had contrast capabilities at 256 levels. It was also the only color scanner of this type.

The desktop publishing scanners have appeared on the market within the last three years. They are designed for use primarily with IBM PC/XT/AT, and some interface also with the Apple Macintosh. All have software support or may be used with existing software packages for the personal computers. Most can be used with larger machines, although the software can not. All use bit-mapping as a standard file format, and all perform some type of data compression.

Tabletop scanners are the technology from which desktop publishing scanners evolved. These scanners consist of a camera mounted on a camera stand. They can be used to scan up to E-size drawings (36 x 48 inches), and can be focused on a tabletop or wall. These scanners are designed for very high-resolution precision scanning and are used in medical, geological, research and development (R&D), and operational engineering market (OEM) fields. Three vendors are included in the survey: Eikonix, Datacopy, and Xyztec. The Eikonix and Datacopy scanners have been on the market for several years, and the Xyztec scanner will not be on the market until November 1987. The Datacopy scanner lists at $18,000.00 and the Eikonix and Xyztec scanners list at $35,000.00.

The tabletop scanners have very high resolution, surpassing the discrimination of the human eye, thus allowing the computer to detect, enhance, and display features of the image which could not normally be

seen upon visual inspection. DPI resolution varies with the size of the area scanned. Eikonix offers the highest pixel density with their Series 850 cameras which capture 4096 x 5200 pixels per image. With the exception of the Howtek Scanmaster, only the tabletop scanners offer contrast at 256 levels. Eikonix offers the highest contrast with their Series 78/99 cameras which have 12 bits per pixel, resulting in 1024 grey levels. Eikonix and Xyztec offer full-color systems; the Datacopy system scans in black and white.

The tabletop scanners run on virtually any minicomputer and interface with IBM PC/XT/AT personal computers. Only Datacopy offers software support, and only for IBM personal computers.

Fact sheets on optical scanners are provided in Figure C-1.

Product:	Abaton Scan 300
Vendor:	Abaton Technology Corp. 7901 Stoneridge Dr., Suite 500 Pleasanton CA 94566
Phone:	415-463-8822
Scan Type:	Roller-feed
Scan Element:	CCD Sensor
Pixel Resolution:	300 DPI
Contrast Resolution:	12 half-tone patterns yielding 32-levels
Price:	$2,495.00
Size:	15 x 17 3/8 x 4 5/8 inches
Power:	60W
Max Scan Size:	8.5 x 14 inches
Scan Speed:	MacIntosh: 1-2 minutes; IBM 386: 20 seconds
Color:	No
File Format:	Bit mapped, Normal, TIFF, Noncompressed, Postscript, MacPaint
Host:	Macintosh; IBM PC/XT/AT and compatibles
Host Interface:	Macintosh: Serial; IBM: Parallel
Intended Use:	Desktop Publishing
Software:	C-scan: scaling, brightness, contrast, editing
OCR Capability:	Yes

Figure C-1. Scanner Fact Sheets

Product:	Datacopier 730
Vendor:	Datacopy Corp. 1215 Bella Ave. Mountain View CA 94043
Phone:	800-556-1234 415-965-7900
Scan Type:	Flatbed
Scan Element:	CCD Sensor
Pixel Resolution:	300 DPI
Contrast Resolution:	4-bit, 16 grey levels; note software processes as 1-bit
Price:	$3,950.00
Size:	5.6 x 15.2 x 19.5 inches; 17.6 pounds
Power:	110W
Max Scan Size:	8.5 x 14 inches
Scan Speed:	14 seconds/page at 300 DPI
Color:	No
File Format:	Bit mapped
Host:	IBM personal computers and compatibles; Apple Macintosh
Host Interface:	Custom parallel
Intended Use:	Desktop Publishing
Software:	OCR Plus, PCImage, MacImage, MicroFax
OCR Capability:	Yes with appropriate software

Figure C-1. (Continued)

Product:	Series 900 Electronic Digitizing Cameras and Image Processing Systems; Series 600 Electronic Digitizing Cameras
Vendor:	Datacopy Corp. 1215 Bella Ave. Mountain View CA 94043
Phone:	800-556-1234 (x 96) (referred) 415-965-7900 (main offices)
Scan Type:	Tabletop
Scan Element:	34-Element CCD Array
Pixel Resolution (DPI):	400 DPI; 4472 x 3456; 15,455,232 pixels
Contrast Resolution:	8-bit, 256 levels
Price:	$18,000.00
Size:	Model 612 and 620: 3.6 x 6.8 x 8.5 inches, 6.4 pounds Model 612F and 620F: 6 x 6.8 x 8.5 inches, 6.6 pounds Copy Stand: 40 x 25 x 25 in.
Power:	115 VAC, 700W, 6 amps, 50/60 Hz
Max Scan Size:	Depends on lens, accommodates E drawings
Scan Speed:	8.5 x 11 inches in 25 seconds, longer with full grey

Figure C-1. (Continued)

Series 900
Datacopy
Concluded

Color:	No, but could put color lenses on camera; no problem scanning and displaying color photographs
File Format:	Binary
Host:	IBM PC/XT/AT, most compatibles, Multibus, DEC Q-bus supported; 8-bit wide bidirectional data/command interface for engineering interface to other systems
Host Interface:	General purpose customized interface card
Intended Use:	CAD, OEM, publishing
Software:	With IBM, WIPS included provides image capture, display, composition, utilities; optional WIPS EDITOR, WIPS jr, CAD/camera (converts to vector files), OCR Plus
OCR Capability:	Yes, with appropriate software

Figure C-1. (Continued)

Product:	PC Scan Plus
Vendor:	DEST Corp. 1201 Cadillac Ct. Milpitas CA 95035
Phone:	800-538-7582 (dealer referred)
Scan Type:	Roller feed
Scan Element:	CCD Sensor
Pixel Resolution:	300 DPI
Contrast Resolution:	Dithered half tones
Price:	$2120.00
Size:	N/A
Power:	N/A
Max Scan Size:	8.5 x 14 inches
Scan Speed:	N/A
Color:	No
File Format:	Bitmapped
Host:	Macintosh, IBM PC compatibles
Host Interface:	Interface Card
Intended Use:	Desktop Publishing, OCR
Software:	Publish Pac, Text Pac, not included
OCR Capability:	Yes

Figure C-1. (Continued)

Product:	Series 850/Series 78/99 Linear Photo Diode Array
Vendor:	Eikonix Corp. (Kodak) 23 Crosby Dr. Bedford MA 01730
Phone:	617-275-5070
Scan Type:	Tabletop
Scan Element:	CCD Array
Pixel Resolution:	Series 850: 4096 x 5200 Series 78/99: 2048 x 2600
Contrast Resolution:	Series 850: 8-bit, 256 colors Series 78/99: 12-bit, 1024 colors
Price:	$35,000.00
Size:	24 x 24 inches, tabletop
Power:	115 VAC, 15 amps
Max Scan Size:	E size at 100 DPI
Scan Speed:	3-5 minutes per scan
Color:	Full color
File Format:	Bitmapped, user given raw data
Host:	Full support for DEC and IBM PC; coming out with VME interface
Host Interface:	Interface card
Intended Use:	R & D; digitize reflective imagery: maps, photographs, medical; users are government, military, medical, university
Software:	Driver, also computes data compression
OCR Capability:	No

Figure C-1. (Continued)

Product:	Scanmaster
Vendor:	Howtek 21 Park Ave. Hudson NH 03051
Phone:	603-882-5200
Scanner Type:	Flatbed
Scanner Element:	CCD Sensor
Pixel Resolution:	300 DPI
Contrast Resolution:	8-bit, 256 levels
Price:	$5995.00
Size:	19.7 x 18.9 x 6.7 inches
Power:	120W
Max Scan Size:	11 x 17 inches
Scan Speed:	8.5 x 11 inches 300 DPI in 15 seconds; 11 x 17 inches in less than 50 seconds
Color:	Single pass RGB color separation
File Format:	Bitmapped
Host:	IBM PC, VMEbus, Miltibus, DEC Q-bus
Host Interface:	8-bit IEEE parallel interface. IEEE hardware interfaces to MS-DOS, Unix, some DEC systems.
Intended Use:	Desktop Publishing
Software:	Image processing (PC only). Optional source code for C-callable library of functions, device drivers.
OCR Capability:	No

Figure C-1. (Continued)

Product:	ScanJet Desktop Scanner
Vendor:	Hewlett-Packard 80020 Foothills Roseville CA 95678
Phone:	800-FOR-HPPC (dealer referred)
Scanner Type:	Flatbed
Scanner Element:	CCD image sensor
Pixel Resolution:	2550 dots (yielding 300 DPI)
Contrast Resolution:	4-bit, 16 levels, dithered half tones
Price:	$1495.00
Size:	3.3 x 14.5 x 22.4 inches, 22.8 pounds
Power:	120W
Max Scan Size:	8.5 x 14 inches
Scan Speed:	20.4 seconds at 300 DPI
Color:	No, yellow is drop-out color
File Format:	TIFF, MS Paint, PC Paintbrush
Host:	HP Vectra PC, IBM PC/XT/AT (requires interface kit)
Host Interface:	Bidirectional Centronics
Intended Use:	Desktop Publishing
Software:	Scanning Gallery Software (included): scanning, cropping, storage; some applications have built-in support.
OCR Capability:	No

Figure C-1. (Continued)

Product:	Intelligent Image Scanner (MS 300A)
Vendor:	Microtek 16901 S. Western Ave. Gardena CA 90247
Phone:	800-654-4160
Scan Type:	Roller Feed
Scan Element:	CCD Sensor
Pixel Resolution:	300 DPI
Contrast Resolution:	65 grey shades, 12 half tone patterns
Price:	$2,495.00
Size:	14.96 x 4.57 x 17.32 inches, 19 pounds
Power:	60W
Max Scan Size:	8.5 x 14 inches
Scan Speed:	10 seconds/page
Color:	No
File Format:	Bitmapped
Host:	Macintosh, IBM PC Compatibles
Host Interface:	TTL-compatible parallel, RS-232-C/RS-422 serial
Intended Use:	Desktop Publishing
Software:	Graphics software for editing, customer uses own paintbrush software
OCR Capability:	PC now, Macintosh late summer, ASCII format

Figure C-1. (Continued)

Product:	Compound Document Processor
Vendor:	Palantir Corp. 2500 Augustine Dr. Santa Clara CA 95054
Phone:	408-986-8006
Scan Type:	Roller feed
Scan Element:	CCD Sensor
Pixel Resolution:	300 DPI
Contrast Resolution:	N/A
Price:	$39,500.00
Size:	10 x 17 x 29 inches
Power:	N/A
Max Scan Size:	8.5 x 14 inches
Scan Speed:	8 pages/minute
Color:	No
File Format:	Proprietary; text ASCII, graphics CCITT group 3 or group 4 facsimile
Host:	Unix, DOS (AT), network capability
Host Interface:	Serial, Ethernet, Massbus
Intended Use:	Desktop Publishing
Software:	Not included
OCR Capability:	Yes, integrated one pass, ASCII output

Figure C-1. (Continued)

Product:	LS-300
Vendor:	Princeton Graphic Systems 601 Ewing St., Bldg. A Princeton NJ 08540
Phone:	800-221-1490 (x 92)
Scan Type:	Roller feed
Scan Element:	CCD Sensor
Pixel Resolution:	300 DPI
Contrast Resolution:	32 dithered halftones; pale blue/ yellow dropout colors
Price:	$1,095
Size:	13 5/8 x 11 5/8 x 3.5 inches
Power:	120 VAC, 75 VA
Max Scan Size:	11 x endless inches but available software limited to 8.5 x 11 inches
Scan Speed:	8.5 x 11 inches in 12 seconds
Color:	No
File Format:	Bitmapped, FAX
Host:	PC compatibles, Macintosh version called MacScan
Host Interface:	SCSI, 8 bit, parallel; speed 1.25 Million bits/SCC
Intended Use:	Desktop Publishing
Software:	Packaged with PC Paintbrush
OCR Capability:	OCR option. PC version with OCR $1,495.00 including software. Macintosh version with OCR $1549.00 including software

Figure C-1. (Continued)

Product:	XYZTEC Scanwriter
Vendor:	Xyztec Corp. PO Box 11190 Pueblo CO 81001-0190
Phone:	303-850-9400
Scan Type:	Tabletop
Scan Element:	CCD Sensor
Pixel Resolution:	1000 LPI
Contrast Resolution:	8-bit, 256 grey levels, has bit compression
Price:	$35,000.00
Size:	48 x 24 inches
Power:	N/A
Max Scan Size:	E size, 36 x 48 inches
Scan Speed:	6 inches/minute, 6 minutes full pass 1000 lines, 3 passes for color
Color:	Full color
File Format:	Proprietary
Host:	Anything that interfaces through SCSI
Host Interface:	SCSI Interface Board
Intended Use:	OEM Market
Software:	No
OCR Capability:	No

Figure C-1. (Concluded)

APPENDIX D

MONITOR AND GRAPHICS BOARD MARKET SURVEY

APPENDIX D

MONITOR AND GRAPHICS BOARD MARKET SURVEY

Display Technology

Display of video images, scanned images, and computer generated text and graphics is accomplished with a graphics board and a monitor. This discussion of currently available display technology is particular to ASAS/ENSCE trainers, and is based on the following assumptions:

1. A high-resolution video I/O subsystem will be needed to display ASAS/ENSCE computer-based training sequences consisting of still photography, high-resolution scanned images, and video sequences with graphic and text overlays.

2. High resolution is essential to the ASAS/ENSCE trainer application.

3. Color displays are desirable but not essential to the ASAS/ENSCE trainer application.

4. Touch screens are not prerequisite to the ASAS/ENSCE trainer application.

5. Interest is in video display subsystems that will provide capability beyond that of the EIDS highest-resolution option.

6. Availability of support software for displaying images is desirable but not prerequisite to the ASAS/ENSCE trainer application.

Background

The quality, or resolution, of displayed images depends upon both the monitor and graphics board on thg computer subsystem bus. Together, the monitor and graphics board may be called the video I/O subsystem. The ability to overlay computer graphics or text on video images is a feature of the graphics board. As with scanners, display resolution has two components: pixel density and contrast. Pixel density is the horizontal pixel spacing by the vertical line spacing. For high-resolution display of scanned images, a pixel resolution of 512H x 512V is the minimum requirement. For display of a full page of information on one screen, a pixel resolution of 736H x 1008V is the minimum requirement. Contrast resolution is measured by the number of colors or shades of grey which can be displayed simultaneously. The

simultaneous display of a minimum of 256 colors or shades of grey is required for photographic-quality images.

There are two types of monitors and graphics boards which drive them: digital and analog. Analog systems allow a greatly increased array of grey shades or colors. In digital systems, signals that the board sends to the monitor can be either on or off (2 values), so that a system with 6 color signals can display 64 colors, which is called the "palette." The number of colors that can be simultaneously displayed is much lower. This restriction is based on the amount of video memory and its organization within the graphics board hardware. The Enhanced Graphics Adapter (EGA) boards such as the one included in the EIDS hardware suite are digital systems which can simultaneously display 16 colors out of a palette of 64.

An analog system requires only three color signals: red, green, and blue. However, each of these signals can be varied over a continuous range. To display the 256 colors or levels of grey generated by high-resolution scans, an analog system must be used.

There are two types of analog video systems: interlaced and noninterlaced. Interlacing effectively doubles the pixel resolution by doubling each line across the screen. It duplicates the image of one line, slides it one scan line up, and displays it. In order to display the full resolution of an image scanned at 512H x 512V resolution, a 512H x 512V noninterlaced or 512H x 1024V interlaced video system would be needed.

Summary of Findings

The EIDS hardware standard represents the maximum capabilities achievable with a digital graphics board and digital monitor. To acquire a system which is capable of displaying the high-resolution output of a scanner it will be necessary to replace not only the monitor but also the EGA graphics board of the EIDS suite with an analog video I/O subsystem.

The highest display quality available is with an analog display which has a pixel resolution of 1280H x 1024V with a simultaneous display of 256 colors out of a palette of 16.8 million. A number of graphics boards and monitors are avaklable which achieve this resolution. The requirement for compatible monitors is that they have a horizontal scan frequency of 64KHz which produces a noninterlaced pixel resolution of 1280H x 1024V. These monitors come with 14-, 15-, and 19-inch screens. The graphics boards must have 8 bits per pixel to simultaneously display 256 colors. When text or graphic overlays are used, 2 bits are usually required, reducing the available colors to 64. Between the highest resolution analog video system and the EIDS standard, there is a wide range of alternatives. The average price of the highest resolution analog monitors is $2,500.00 and the graphics boards average at $3,000.00 for the highest resolution models. A list of

vendors of high-resolution monitors and graphics boards is contained in Figure D-1.

The capability of providing input to the computer through a touch-sensitive screen may be added after the desired monitor is selected. A corporation such as Microtouch Systems will retrofit monitors with touch screens. The cost of an Aydin Control 19-inch high-resolution monitor with touch screen added is approximately $5000.00. Information about Microtouch Systems is included in figure D-1.

Monitor Vendors[1]

Vendor Name:	Aydin Controls
Address:	414 Commerce Drive Fort Washington PA 19034
Phone:	215-542-7800
Model:	Patriot 8865
Characteristics:	Resolution 1280H x 1024V, analog, color, noninterlaced, 19-inch screen. GSA prices offer 40% discount off list price.

Vendor Name:	Electrohome, Ltd.
Address:	809 Wellington St., N. Kitchener, Ontario, Canada N2G 4J6
Phone:	519-744-7111 (dealer referred)
Model:	1911
Characteristics:	Resolution 1024H x 512V noninterlaced, 1024H x 800 interlaced, analog.

Vendor Name:	Mitsubishi
Address:	991 Knox St. Torrance CA 90502
Phone:	213-515-3999 (dealer referred)
Model:	HG-6905, FG-6600, and others
Characteristics:	Resolution 1024H x 512V, analog, color, noninterlaced, 15-inch and 19-inch screens.

Vendor Name:	Moniterm
Address:	5740 Green Circle Dr. Minnetonka MN 55343
Phone:	612-935-4151
Model:	CD1920
Characteristics:	Resolution 1280H x 1024V, analog, color, noninterlaced, 19-inch diagonal screen.

Touch Screen Vendors

Vendor Name:	Microtouch Systems
Address:	10 State St. Woburn MA 01801
Phone:	617-935-0080
Characteristics:	Retrofit customer's monitor with touch screen or will provide a monitor with touch screen.

[1]There are numerous manufacturers of high-resolution monitors, many of which were contacted for this survey. The list of vendors presented here represents only those who responded to this survey.

Figure D-1. Video Display Vendors

Graphics Board Vendors[1]

Vendor Name:	ATT
Address:	2002 Wellesley Blvd. Indianapolis IN 46219
Phone:	317-841-0332 (dealer referred)
Model:	Targa 32
Characteristics:	Resolution 512H x 480V (noninterlaced) with 16.77 million simultaneous colors; captures live video images, overlays stored images onto live video.
Model:	Vista
Characteristics:	Available Fall 1987; resolution 1024H x 1024V (noninterlaced) with 16.87 million simultaneous colors.
Vendor Name:	Control Systems
Address:	2675 Patton Rd., POB 64750 St. Paul MN 55164
Phone:	612-631-7800
Model:	Artist 10/1280
Characteristics:	Available Fall 1987; resolution 1280V x 1024H (noninterlaced) with 256 simultaneous colors.
Vendor Name:	Imagraph Corp.
Address:	800 W. Cummings Pk., Suite 4400 Woburn MA 01801
Phone:	617-938-5480
Model:	AGC-1024P
Characteristics:	Resolution 1024H x 1024V (noninterlaced) with 256 simultaneous colors.
Vendor Name:	Matrox
Address:	1055 St. Regis St. Dorval, Quebec, Canada H9P 2T4
Phone:	514-685-2853
Model:	PG-1280
Characteristics:	Resolution 12804H x 1024V (noninterlaced) with 256 simultaneous colors.

[1]There are very few manufacturers of high-resolution graphics boards. While the list of vendors presented here is not comprehensive, it represents every vendor that we were able to locate in the course of this survey.

Figure D-1. (Continued)

Graphics Board Vendors[1]

Vendor Name:	ATT
Address:	2002 Wellesley Blvd. Indianapolis IN 46219
Phone:	317-841-0332 (dealer referred)
Model:	Targa 32
Characteristics:	Resolution 512H x 480V (noninterlaced) with 16.77 million simultaneous colors; captures live video images, overlays stored images onto live video.
Model:	Vista
Characteristics:	Available Fall 1987; resolution 1024H x 1024V (noninterlaced) with 16.87 million simultaneous colors.
Vendor Name:	Control Systems
Address:	2675 Patton Rd., POB 64750 St. Paul MN 55164
Phone:	612-631-7800
Model:	Artist 10/1280
Characteristics:	Available Fall 1987; resolution 1280V x 1024H (noninterlaced) with 256 simultaneous colors.
Vendor Name:	Imagraph Corp.
Address:	800 W. Cummings Pk., Suite 4400 Woburn MA 01801
Phone:	617-938-5480
Model:	AGC-1024P
Characteristics:	Resolution 1024H x 1024V (noninterlaced) with 256 simultaneous colors.
Vendor Name:	Matrox
Address:	1055 St. Regis St. Dorval, Quebec, Canada H9P 2T4
Phone:	514-685-2853
Model:	PG-1280
Characteristics:	Resolution 12804H x 1024V (noninterlaced) with 256 simultaneous colors.

[1]There are very few manufacturers of high-resolution graphics boards. While the list of vendors presented here is not comprehensive, it represents every vendor that we were able to locate in the course of this survey.

Figure D-1. (Continued)

Vendor Name:	Number Nine
Address:	725 Concord Ave. Cambridge MA 02138
Phone:	617-492-0999
Model:	Pepper Pro 1280
Characteristics:	Resolution 1280H x 1024V (noninterlaced) with 256 simultaneous colors.

Vendor Name:	PGX Inc.
Address:	3730 Skypark Dr. Torrance CA 90505
Phone:	213-539-6400
Model:	HR 1280-8
Characteristics:	Resolution 1280H x 1024V (noninterlaced) with 256 simultaneous colors.

Vendor Name:	Vectrix
Address:	2606 Branch Wood Dr. Greensboro, NC 27408
Phone:	919-288-0520
Model:	Presto
Characteristics:	Available winter 1987; resolution 1280H x 1024V (noninterlaced) with 256 simultaneous colors.

Graphics Board and Monitor Pairs

Vendor Name:	Moniterm Corp.
Address:	5740 Green Circle Dr. Minnetonka MN 55343
Phone:	612-935-4151
Model:	Viking 10 System
Characteristics:	Display resolution 1024H x 768V (noninterlaced), IBM AT compatible, 19-inch monitor.

Figure D-1. (Concluded)

APPENDIX E

UPGRADING MATROX EIDS FOR HIGH-RESOLUTION OPTICAL SCANNING

APPENDIX E

UPGRADING MATROX EIDS FOR HIGH-RESOLUTION OPTICAL SCANNING

The Matrox EIDS can be modified to integrate high-resolution image digitization and display. The authoring/pre-mastering stations must be upgraded to be able to scan, manipulate, and store images. Both the playback and authoring/pre-mastering stations must be upgraded to be able to display high-resolution images.

Authoring/Pre-Mastering Upgrades

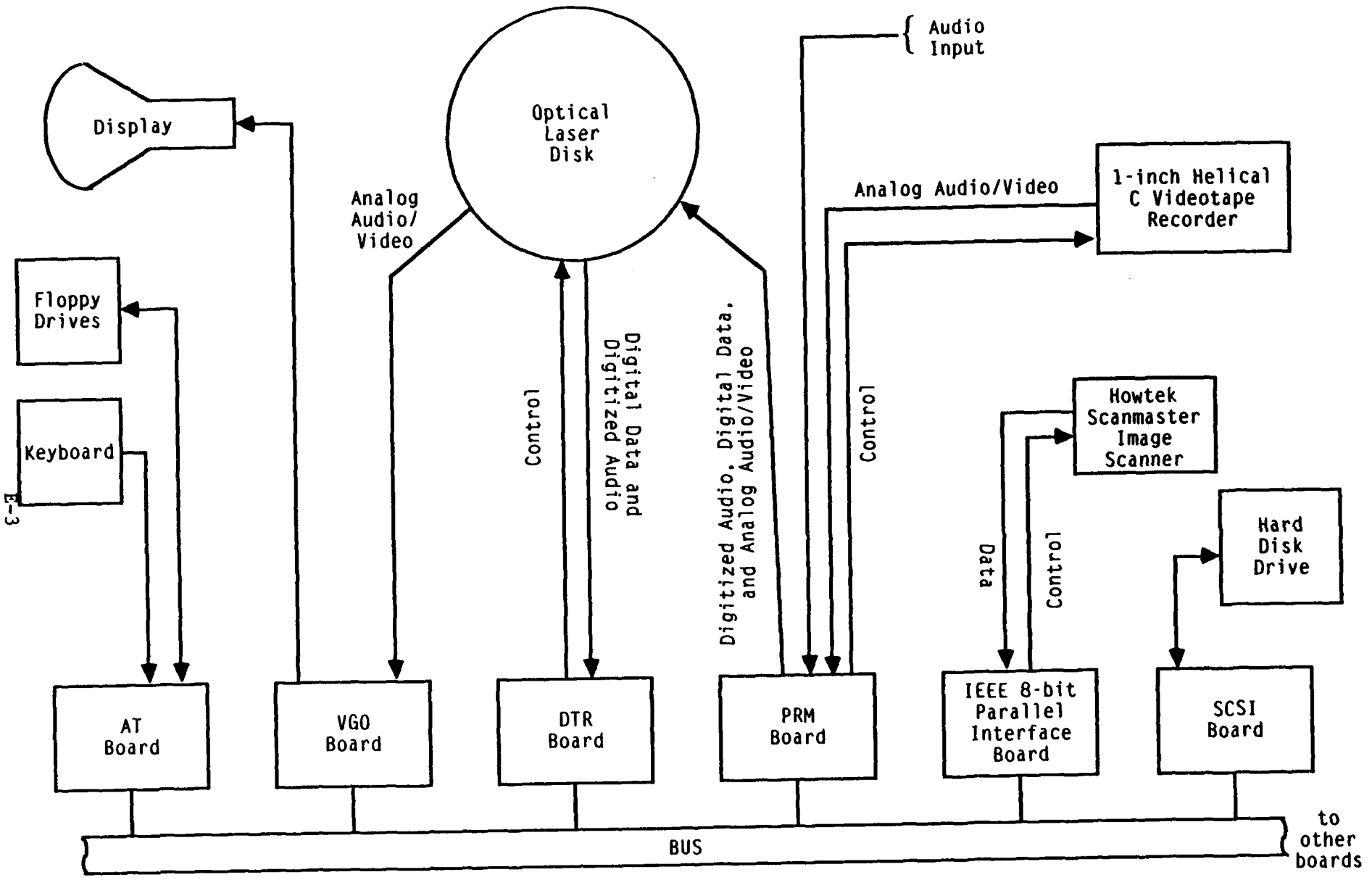
An optical scanner must be added to the authoring/pre-mastering station so that high-resolution images can be stored on the optical disk (only the pre-mastering board is capable of storing digital data on the optical disk). An interface card for the scanner is needed, and software to manipulate and store digitized images must also be added. The diagram in figure E-1 illustrates the hardware configuration of an authoring/pre-mastering station with an image scanner added (but with out changes to the video display subsystem).

The Howtek Scanmaster is an example of a high-resolution scanner. It produces a pixel density of 300 DPI (2550H X 3300V for an 8.5 x 11-inch image) with 256 grey levels or colors out of a palette of 4096. A digitized 8.5 x 11-inch image requires 15MB of storage. One digitized image requires less than one percent of the capacity of an optical disk, whereas it requires almost 20 percent of the capacity of the largest magnetic hard disk offered with the Matrox system. The Howtek Scanmaster produces images in any of three formats (Hewlett-Packard plotter format, ATT Targa format, and RSIM standard color image format) for manipulation by third-party software. The Howtek Scanmaster interfaces to the AT computer bus with an 8 bit IEEE standard parallel interface card.

Playback and Authoring/Pre-Mastering Upgrades

The graphic display capability of the baseline Matrox hardware has inadequate resolution to display the high-resolution images produced by the Howtek Scanmaster. It has a oczkmum pixel resolution of only 720H x 480V with 16 colors. There are a variety of graphics boards and monitors available to display the digitized images with near-photographic quality. The Matrox PG-1280 and the PGX HR-1280-8 boards both have 1280H x 1024V pixel resolution with 256 colors. The Aydin Control Patriot Model 8865 is one example of a monitor able to display 1280H x 1024V with 256 colors.

Upgrading the Matrox hardware for high-resolution graphics display is not simply a matter of replacing the current graphics board and monitor. The current video graphics overlay (VGO) board contains a ROM chip with BIOS for both the digital data recovery (DTR) board and the



*Without Upgraded Graphics Board and Monitor

Figure E-1. Matrox Authoring/Pre-Mastering Station With Image Scanner*

VGO board. The VGO board cannot be removed because the DTR board, responsible for decoding digital data from the optical disk, would become unusable. Matrox is contemplating putting the DTR BIOS on a version of the PG-1280 board, but has no current plans to do so.

Consequently the VGO board must be left in place. This suggests two possible design alternatives as illustrated in figure E-2. In the first alternative two monitors are used. One monitor is used exclusively for high-resolution images. The second monitor is used for all other EIDS purposes including video presentation and text/graphics overlay, but cannot display the high-resolution images.

In the second alternative only one monitor is used. It is used for both video overlay and display of high-resolution images. The VGO board is not used, except to access ROM. The video disk player output is directed to the high-resolution graphics board which must have the ability to overlay graphics. Both the Matrox and PGX boards can be ordered with the Gen/Lock option for overlay capability.

Unfortunately, there is a potential problem with software interfaces in the second alternative. Text must be drawn in high-resolution graphics for display through the high-resolution boards. Most software, including the MS-DOS operating system, relies on the BIOS to create the character images for display. The standard BIOS on the PC AT board (and on the VGO board) are not compatible with display at 1280H x 1024V with 256 colors. The PGX board has a ROM chip with replacement BIOS that supports text display without requiring changes in the applications programs. The Matrox board and most other high-resolution boards do not have this feature. There may also be problems with graphics created by software designed for use with a lower resolution board. These problems can only be addressed on a case-by-case basis. Special software may have to be written to display high-resolution images in conjunction with courseware.